CIVIL ENGINEERING

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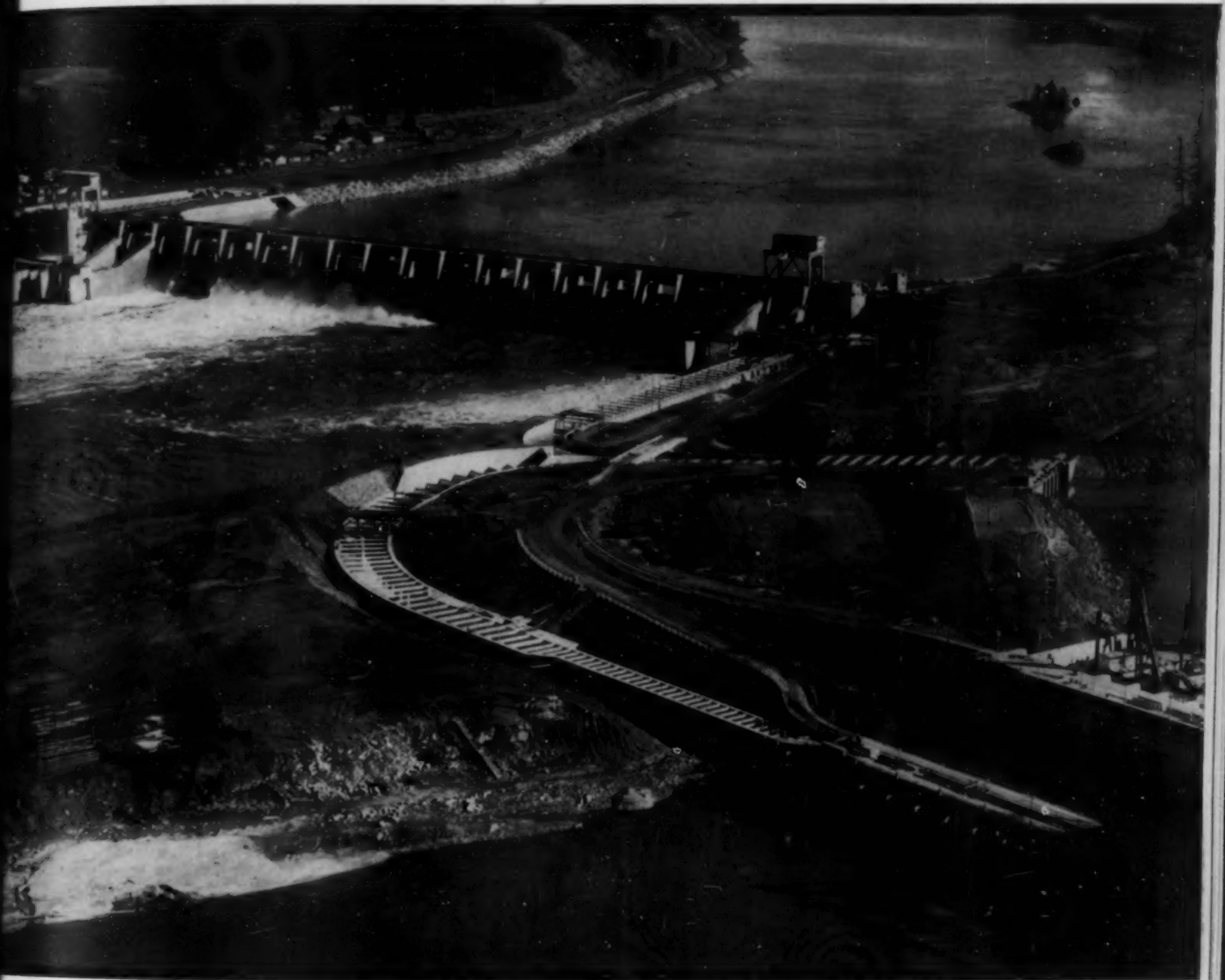

FISH LADDERS AT BONNEVILLE DAM PROVIDE FOUR ROUTES FOR MIGRATORY SALMON
For Another Solution of This Vital Economic Problem, See Article, Page 181

Volume 13 AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 Number 4

APRIL 1943

Will all this be for you?

Peace! 194(?) Heroes will be returning to these shores—and some are already here. Are you among them? Will the shouting and the noise of the bands be intended for your ears? Will you deserve a place in the victory parade? That all depends on what you are doing today.

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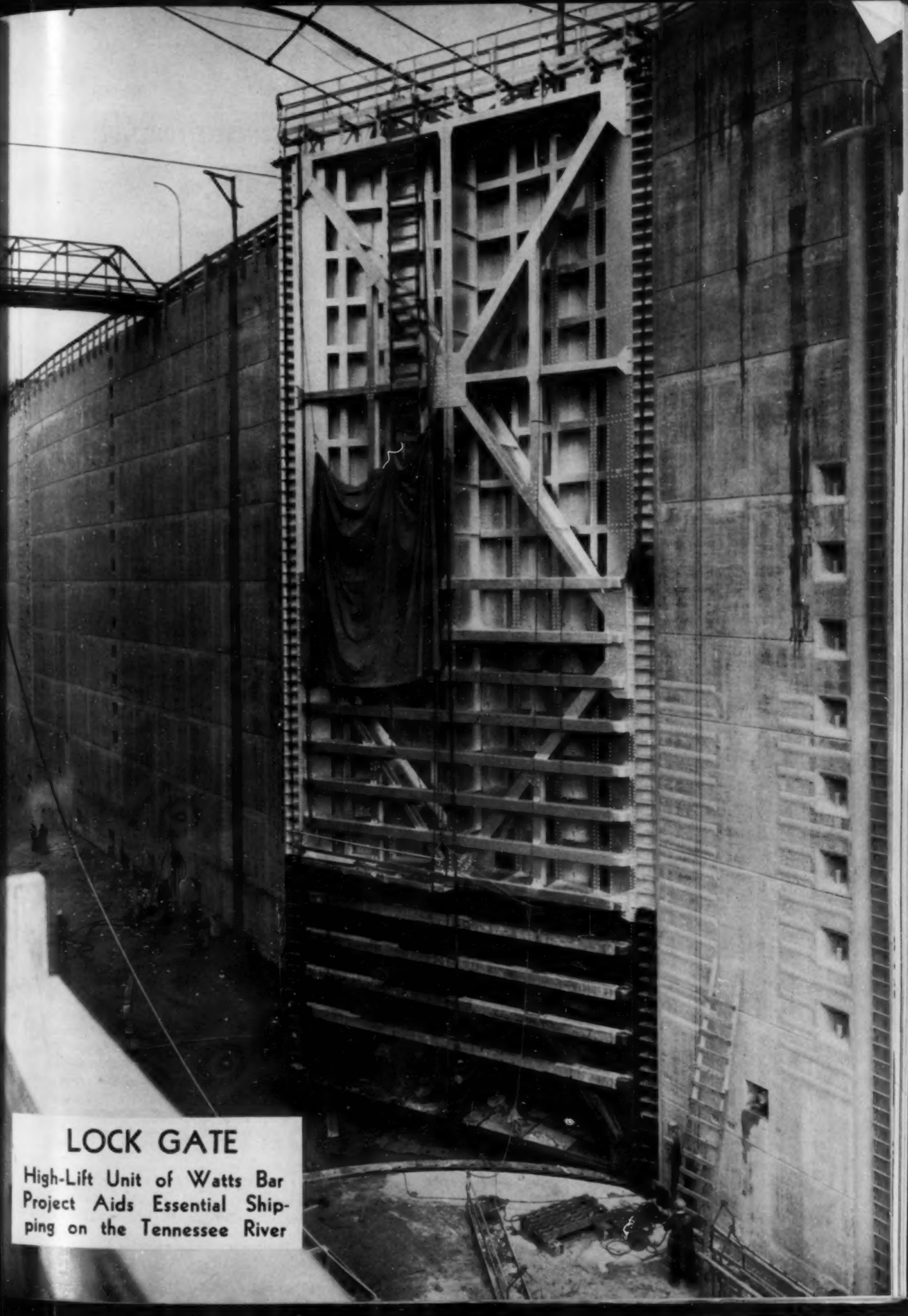

LOCK GATE

High-Lift Unit of Watts Bar Project Aids Essential Shipping on the Tennessee River

Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

A Crisis in Education

An Authority Challenges Wartime Trends—Condensed from the Detroit "Free Press"

By Mortimer E. Cooley, Hon. M. Am. Soc. C.E.

Dean Emeritus, College of Engineering and Architecture, University of Michigan, Ann Arbor, Mich.

For more than thirty years I have sought to increase rather than lessen the cultural training of engineers. Now once more, this time from near the hilltop of life, I raise my voice. I cannot remain silent.

In the field of education, as I see it, the present trend, not only of technical education but of education generally, is in exactly the opposite direction from the one to which I have devoted my life. This is not only a grievous disappointment to me personally, but I fear a grave mistake that will have serious consequences. For I am thoroughly convinced that the late great President Angell, of the University of Michigan, was right when he said to me, not long before his death, "Mr. Cooley, after all my years in teaching and in public life at home and abroad, I have reached one definite conclusion: If this democratic form of government of ours is to endure, we will have to have a different kind of education."

Dr. Angell was referring to the trend of education towards more and more specialization, with less and less general training in history and the social sciences, philosophy, literature, and the arts. He felt that in this trend lies a civilization which, lacking the fundamental human values, cannot survive.

Retrogression, by Contrast.~In the sixty years I have been intimately connected with engineering education in this country, the curriculum for engineers has become more and more technical. To make room for new technical subjects, general subjects have had to be dropped. Most of our great engineers of the past century were products of a different kind of training. Theirs was an education broader than that of today.

There were comparatively few fields of engineering, and not many textbooks; in a four-year course the work required for graduation of necessity included many so-called cultural studies. It was not uncommon to find both Latin and Greek among the accomplishments of engineer graduates. The engineer with such training was a man of vision, a wise counselor in great enterprises—those which involved knowledge of people as well as of technical things. It was through the vision of such engineers that our great transcontinental railroads were built, our great bridges began to span the mighty rivers, our highways to weave across the nation, and the world to move on wheels and by motor power.

After 87 years of living in this world, 47 of them as an engineering educator, 60-odd as a practicing engineer, I think I know the engineering profession—its needs, its failings, its possibilities—as well as anyone. And I know the problem of education in wartime. As an educational director of the Student Army Training Corps during World War I, I was directly responsible for the adaptation to wartime needs of curricula in 72 colleges and universities.

War Always Induces Losses.~I am not unfamiliar with the hysteria which is a part of war. One of the first things a university feels impelled to do is to guard its enrolment. When deferment of students to attend college is no longer expedient because of the military needs of the country, then the college feels compelled to adapt its curricula to training for wartime alone. No one will deny the responsibility of the college to include in its curricula every subject needed for wartime purposes. Within the framework of already existing curricula such courses should be added, and should be required of all students who can make use of them. But once a university turns itself into a college for war purposes alone, it loses its value as an educational institution in the broader meaning of the term "education." For instance, during the last war we dropped training in Greek and Latin as a requirement for the literary degree. These courses were never reestablished except as electives.

Whence Leadership?~Most young people have only four years in college; in wartime they have even less than that. They have forty years afterward in which to learn and practice the bread-and-butter part of life. The one great need today is training for responsible leadership. I am told the greatest present lack in the armed forces is not intelligent officer material. There is intelligence enough—the lack is leadership. And this lack, I am sorry to say, is nowhere more pronounced

than among engineers, whose services are so greatly needed in wartime.

Leadership is a quality which comes only from a well-disciplined mind, from a sense of responsibility, from learning to think straight—and quickly, on one's feet, as it were, because such straight thinking is habitual. The quality is not absorbed, as technical or other knowledge, in capsule form, with the result that at examination time knowledge comes forth in the form of reflected light rather than from a light within. Education is a mental process. The only way to stretch the mind is to put it in contact with something bigger than itself. This bigger thing is represented by the best minds and the best thinking found in the past. And this is the material which forms the basis of a cultural training in history and the social sciences, languages, philosophy, literature, and the arts.

The Germans' Greatest Lack.—During the last war, and I hope in this war, the supreme weakness of the German system of militarism was carrying specialization to such a point that vision beyond the immediate task in hand was impossible, not only for the men in the ranks but for the military leaders. German diplomacy could not grasp the psychology and spirit of other peoples.

German war preparation became so intensive, so specialized, that when certain operations went wrong, when certain sources of supply became inaccessible, the great machine fell of its own weight. German naval and military systems failed because the Allies and the United States did not act according to a German-made schedule of things. The specialist, whether military, industrial, technical, or executive, without his "schedule," prepared and learned by rote, is nonplussed and conquered when his carefully built plan goes wrong, when unexpected obstacles are faced.

It was a great force of civilian-trained officers and men, stepping from the ranks of unmilitary life into the trenches after a few months of intensive preparation, who drove the German war specialists before them. Just as Prussianism in method failed in the last war, so will too great specialization fail in this war. Let us beware of making a mistake so clearly outlined for us. Never was there a more crying need for an educational system which will develop individual rather than unplastic models, each a duplicate of the others in his own profession or trade.

Broader Vision Needed.—Certain technical training is, of course, essential to war. Let no one argue to the contrary. But for the students who are in college to be deprived of everything except this technical training, with no regard for the future when they will have to assume responsibility for the world in which they live, will be a tragic error—an error which I think our so-called "higher education" may not survive. Even in the Army camps the soldiers are being taught to think about the background of this war, why they are fighting, why it is essential that we win.

Modern education, as I see it, has been very much engaged in teaching us how to earn money more easily, without teaching us how to spend it more wisely. It has broadened the scope of human endeavor, opened the way to unparalleled wealth, enabled us to live in marvelous material surroundings. But it has not taught us how to run our world of nations without periodic conflagrations of war. It has, instead, narrowed our human relations, dulled our appreciation of natural pleasures, lessened our sense of spiritual values. The forces loosed as a result of our lack of balance are now engaged on the battlefield.

More, Not Less, Education!—Science and its applications have made all nations neighbors—so near that the most distant point is within reach of the human voice, and within reach by air travel within a few hours. But our progress has led to world-wide unrest. The curricula of our universities and of the technical colleges should be developed, not curtailed, to restore a balance to education. There should be more, not less, education. But it should be in the fundamentals, eschewing all fads, and keeping the so-called "cultural" subjects, apparently having nothing to do with earning a living or winning a war.

To such a program let there be added the technical training, military drill, and physical fitness courses required for war. Let students carry more hours; let them work harder; let them experience the very real discipline of study by reasoning, not by listening and repeating what is heard. The best training for the rigors of military life, where duty is on a twenty-four-hour basis, is less "fun," and even less personal freedom, and more disciplined routine with close attention every moment to the real job to be done.

Keep Education's Lamp Burning.—Serious-mindedness is a good wartime attitude. Let there be Saturday classes, and no vacations; let students go to school from 8 in the morning until 5 in the afternoon, and study under supervision for certain hours each evening. Let the student do more of his learning by study, and less by taking the product his teacher has prepared. Thus teaching time can be reduced, and a faculty enabled to teach more courses, not less.

Wartime is no time for having fun. Let fun be the first thing dropped from the curricula. In its place put training in how to think, in how to know good from evil, in how to judge fairly and squarely. There will be time, if all the hours in the day are wisely used, for training in the art of war as well as in the art of living.

Believe me, rationing of gasoline, of coffee, of sugar, and of a hundred other material things can do us no harm; these we can have again once peace returns. But rationing of education, the bulwark of our democracy, will provide mental and spiritual malnutrition which will be irreparable. At a time when the "lights of the world" are going out one by one, we can ill afford to extinguish the light of the educational centers. These should be preserved at all cost as custodians and dispensers of the accumulated knowledge and wisdom of the world.

Interrelated Essentials.—It will be a sad day for institutions of higher learning when they have dropped from the place to which their name entitles them by eliminating from their programs, especially in wartime when the need is greatest, courses which produce real citizens, capable not only of winning a war but of governing a democratic nation. My views can be expressed in simplified form as follows: Education is made up of two parts; first and most important is teaching man how to live to get the most out of life for himself and to give the most to others; the second part is to give him a professional training enabling him to earn the money with which to carry out the first.

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The Design of Recent TVA Projects

II. General Design Considerations

By GEORGE R. RICH, M. AM. SOC. C.E.
CHIEF DESIGN ENGINEER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

CONTINUING a series of comments on basic engineering features of TVA power development, Mr. Rich opens this paper by discussing the selection and location of turbine runners. Also covered are the determination of maximum floods, architectural treatment of structures, relocation of existing appurtenances, and cost of design procedure. This paper is the second in a series describing TVA projects. The first one, which appeared in the March issue, was also by Mr. Rich.

IMPORTANT among the design features of TVA hydroelectric plants is the choice of turbine runners and their location with relation to tailwater elevation. The elevation established for the turbine runner with respect to the tailwater elevation also has a governing influence on the design of the entire power-station substructure, particularly in the case of low-head propeller or Kaplan-type turbine installations. A typical installation of this type at Watts Bar project is shown in Fig. 1. The requisite margin of safety against cavitation of the turbine may be secured either by placing the runner relatively deep with respect to tailwater, with an attendant increase in cost for the deeper structure, or by locating the runner fairly close to tailwater and installing a turbine of larger diameter operating somewhat below its actual power capacity. In the last analysis, determination of this feature becomes a problem in economics. The increased cost of structures and the decreased cost of smaller higher-speed generating machinery in the one case is balanced against the less expensive structures and the larger-diameter turbines and generating machinery operating at proportionately reduced speed in the other case.

For sites overlain by heavy overburden, where sound foundation rock is at deep elevations with respect to tailwater, such as at the Kentucky Dam project, the design will naturally gravitate to the deep type of setting. However, for projects such as Watts Bar, where the foundation rock occurs at a high elevation with respect to tailwater, with comparatively shallow overburden, the natural choice will be the larger, slower wheel and the shallower type of structure.

As a prerequisite to the design of earth dams, the available material from both borrow pits and foundation must be explored and then tested in the soils laboratory. Based on these soil tests and expected field placement methods, safe average values for friction and cohesion are determined. On the basis of these data the dam is ordinarily proportioned by the so-called Swedish slip-circle method to give a factor of stability of at least 1.5 for normal conditions, and 1.3 for the exceptional conditions resulting on the upstream face from rapid drawdown of the reservoir. In localities where the borrow material is deficient in friction and cohesion characteristics, it is often advantageous to provide embankments consisting of a rolled-fill core supported by external rock-fill shells.

For concrete structures, a minimum freeboard of 7 ft is prescribed, while earth dams are given a freeboard of from 10 to 15 ft over the reservoir level for maximum flood conditions. The assumed maximum floods are derived from runoff studies, and the resulting flood magnitude may be summarized approximately by the formula, $Q = 5{,}000\sqrt{\text{drainage area}}$. Sufficient spillway capacity is then provided to discharge this design flood without exceeding the normal maximum pool elevation.

With respect to architectural treatment, the attempt has been made to create not merely a style but a type—a type flexible enough to meet the variety of conditions imposed by both high-head and low-head dams and at the same time permit full utilization of the topographic peculiarities of each site. The architectural treatment is intended to be a simple, straightforward expression of the purpose for which each element is intended. In short, it is functional—but only to the degree that functionalism is recognized as an influence and not as an objective.

POWER STATION, CONTROL BUILDING, AND SWITCHYARD AT WATTS BAR DAM

On the main-river projects such as Watts Bar, the power station is a massive block of

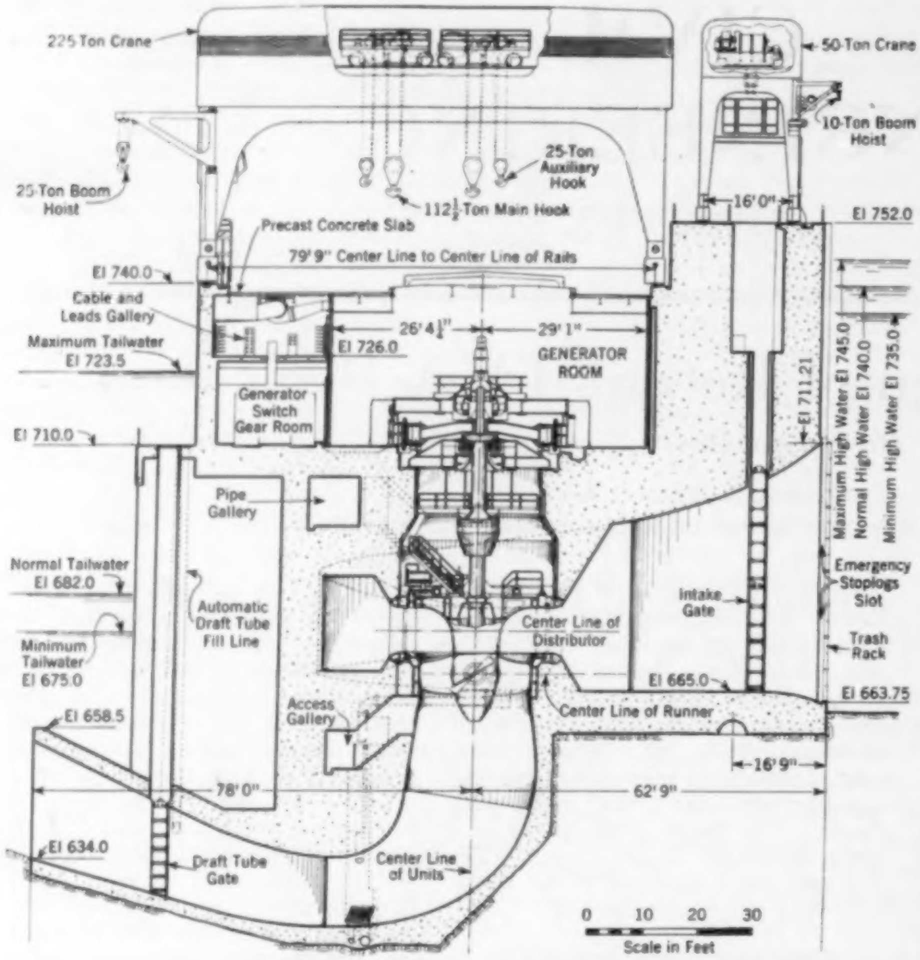


FIG. 1. CROSS SECTION THROUGH POWER STATION AT WATTS BAR PROJECT

concrete in keeping with the rugged character of the dam and lock. But high on an adjacent bluff perches a control building (which may be seen in one of the accompanying photographs) light and fanciful in effect, to add a point of interest to the composition and to provide a vantage point from which visitors may view the engineering development below. At storage projects such as Cherokee, where the large concrete structure of the dam is the dominant feature of the landscape, no attempt is made to create a focal point which might detract from the massiveness of the dam itself. The power station is designed to nestle into the shadow of this gigantic monolith, and by a careful choice of materials and meticulous attention to light and shade, the two elements are made to blend in a pleasing harmony.

Whether for high or low dams, whether in the hills or sprawled across the low, flat main-river valley, the keynote of TVA architecture is simple honesty of purpose.

RELOCATION AND BACKWATER PROTECTION

Each reservoir floods many miles of existing highways and railroads, necessitating replacement by an equivalent system to serve the adjacent area or to permit the continued use of through routes after water is impounded. Reservoir construction also involves a vast volume of diking, dewatering, and backwater protection work, the primary purpose of which is to conserve valuable municipal or industrial areas which would ordinarily come within the reservoir limits but which may economically be segregated without appreciable diminution of storage capacity.

The initial step in the program is to make a preliminary reconnaissance using aerial photographs and topographic and reservoir maps, after which a general plan is evolved. Upon completion of this phase, the location and final survey is started and continuously coordinated with the office activities, permitting a preview of the detailed design before work progresses to a point that would require extensive revision.

Such centralized control produces a well-balanced plan by establishing in advance the basic policies to be adopted, and consistency is maintained between projects. The resulting construction development in its entirety is thus broadly conceived on a coordinated basis from its early inception. This method of producing integrated design reduces construction problems and permits accelerated schedules to be maintained.

To date over 800 miles of highway and 60 miles of railroad have been relocated in various reservoirs. This work has involved the heaviest type of new long-span bridge construction for railroads and highways and the raising of several major existing spans.

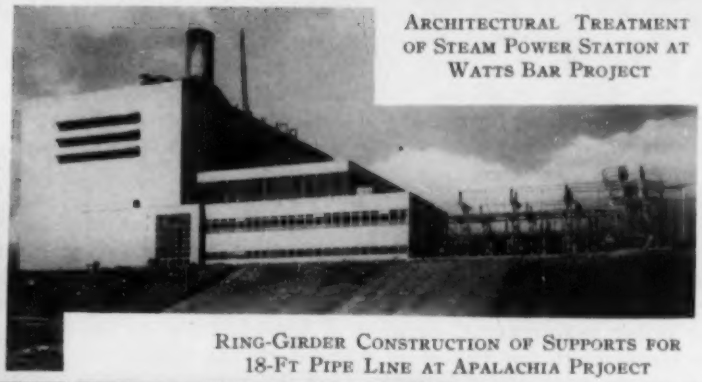
While the volume of design production in the fiscal year 1942 was double that of 1941, design costs decreased from 2% to slightly more than 1% of the total construction expense. This reflects a true saving since the construction costs used in the comparison were adjusted to the price levels of 1941. This economy may be attributed to the following factors:

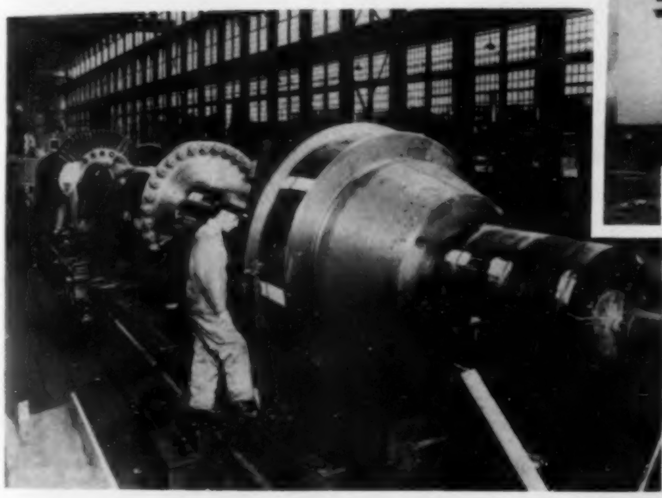
1. Exclusive use of the pool rather than the project system for design.
2. Insistence upon the principle of standardization in design. Hydraulic structures, generating units, gates, cranes, and accessories are not merely designed for the immediate project but are broadly and cleanly conceived to permit repeated economical use without even minor changes on all succeeding projects of similar type.
3. Formulation and close observation of sensitive production indices.
4. Insistence upon complete definition and approval of all fundamental elements of the economic design before undertaking rapid mass production of detail drawings.
5. Rigid adherence to established lines of organization.

This economy has been effected under adverse conditions for obtaining additional trained personnel and in spite of the continuous necessity for changing materials and equipment initially specified to accommodate priority restrictions. These difficulties have been compensated for by the excellent results obtained from creation of a special section for training young graduate engineers, by early coordination and approval of designs required for initiating procurements, and by the splendid spirit of cooperation, and the capacity for assuming responsibility, throughout the organization.

POWER STATION AND SPILLWAY, WATTS BAR DAM

ARCHITECTURAL TREATMENT OF STEAM POWER STATION AT WATTS BAR PROJECT





INSPECTION OF ALINEMENT OF COMBINED TURBINE AND GENERATOR SHAFT

RING-GIRDER CONSTRUCTION OF SUPPORTS FOR 18-FT PIPE LINE AT APALACHIA PRJOECT

BRIDGE RAISED FOR CLEARANCE OVER PONDED WATER, SHOWING ADDITIONS TO PIERS

Two-Stage Biofiltration Sewage-Treatment Plant for an Army Camp

High Degree of Treatment Made Necessary by Ground-Water Conditions

By A. H. Jessup, M. Am. Soc. C.E.

Chief Designing Engineer, Leeds, Hill, Barnard and Jewett, Los Angeles, Calif.

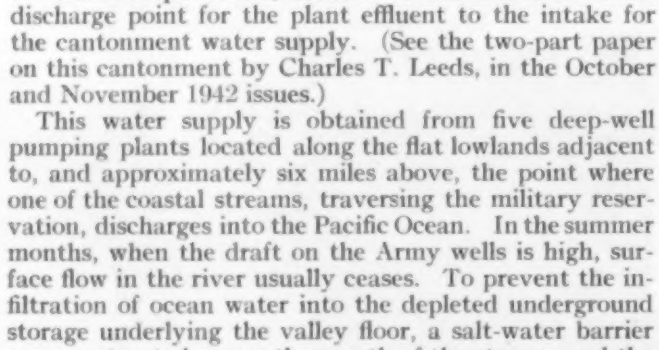
Although the primary requirement for sewage treatment plants at Army cantonments is generally flexibility, in the case here described it is a high degree of treatment. This is because the topography is such that the point of discharge of the effluent is near the wells from which the camp water supply must be drawn. This installation also provides a high degree of flexibility, both in methods of operatiion and in population served. The method used is two-stage biofiltration, including chlorination of final effluent, followed by oxidation and two-stage sludge digestion.

Many factors must be considered in selecting the type of plant and the degree of treatment for the disposal of sewage at Army cantonments. Most military establishments require plants capable of handling wide fluctuations in flow, due to the variation in tributary population. Therefore, plans should be designed to accommodate the change-over to full load from loads as little as 10% of the design capacity, without seriously impairing the quality of the effluent.

In some localities the sanitary requirements of the effluent are not excessive. In others, owing to special considerations, the effluent must receive the highest possible degree of treatment. The sewage treatment plant at one of the Army cantonments recently constructed on the Pacific Coast in California has the latter requirement, because of the closeness of the discharge point for the plant effluent to the intake for the cantonment water supply. (See the two-part paper on this cantonment by Charles T. Leeds, in the October and November 1942 issues.)

This water supply is obtained from five deep-well pumping plants located along the flat lowlands adjacent to, and approximately six miles above, the point where one of the coastal streams, traversing the military reservation, discharges into the Pacific Ocean. In the summer months, when the draft on the Army wells is high, surface flow in the river usually ceases. To prevent the infiltration of ocean water into the depleted underground storage underlying the valley floor, a salt-water barrier was constructed across the mouth of the stream, and the sewage plant effluent is discharged into this so-called underground reservoir. The point of discharge of the effluent is approximately one mile upstream from the salt-water barrier and approximately two miles downstream from the nearest water-supply well.

In the rainy season, when there is surface flow in the river and the underground storage is full, the plant effluent is discharged into the river and flows downstream, passing the barrier and entering the ocean. In the dry season, however, when the underground storage has been depleted by the draft from the water supply wells, the plant effluent sinks into the river bed and builds up the water table in the lower end of the valley, thereby helping to prevent the infiltration of sea water. Obviously, to prevent contamination of the underground water supply, the effluent must receive a high degree of treatment.



Grit Chambers and Diversion Box Looking Along Axis of Plant

Plant Designed for Ultimate Population

Under the first construction program, housing and allied facilities were provided for one armored division and the station complement. However, the utility plants—sewage treatment plant, water treatment plant, pumping plants, and main booster pumping stations—were all designed and constructed to serve an ultimate design population of twice that provided for in the initial construction program. At the present time, the original construction is being supplemented, which will raise the cantonment population to that for which the utility plants were designed and built under the first construction contract. Operating results from the sewage treatment plant records during the first ten months, while the plant has been operating at a capacity of approximately 50% of the design population, consistently show a five-day B.O.D. reduction in excess of 95%.

In order to obtain the desired degree of treatment, and to provide maximum flexibility, both in methods of operation and in tributary population, the two-stage biofiltration process, including two-stage sludge digestion, was selected. The final effluent is chlorinated prior to oxidation, and final disposal is by downward seepage into the underground strata during dry weather, and by direct discharge into the stream bed during the rainy season.

As all utilities are of the semipermanent type, designed for a 20-year life, all structures at the sewage disposal plant, including the central control house, are of reinforced concrete. Gravity piping lines throughout the plant are either vitrified clay tile or concrete pipe. Pressure pumping lines are of cast iron.

As the plant is symmetrical about a central axis, Fig. 1, all the major units, including the various recirculating pumps and piping, are arranged so that either side of the plant may be used as the first stage. Many combina-

tions of operating conditions are thus made possible. Either side of the plant, or both sides in parallel, may be used for single-stage treatment. With either filter out of service, the rest of the plant can be operated to accomplish single-stage complete treatment. Either sedimentation basin may be used independently, or both may be used together in series or in parallel. Two-stage complete treatment is accomplished with all four major units in service. The influent may enter either of the two sedimentation basins.

REQUIREMENTS OF QUARTERMASTER GENERAL

The provisions of the Technical Bulletin on Sewage and Incineration, dated June 20, 1941, issued by the Engineering Branch, Construction Division, Office of the Quartermaster General, were strictly complied with in the basic design of the plant. Pursuant to these requirements, the sewage characteristics were assumed as follows:

Item	Ppm	Lb per Capita per 24 Hr
Suspended solids	460	0.27
B.O.D. (5-day)	290	0.17
Ether-soluble matter	150	0.09

Design of the various units of the plant, including connecting conduits, were based on the following flow characteristics:

Flow per capita per day	70 gal
Average flow	100%
Minimum flow	30% of average flow
Maximum hourly flow	185% of average flow
Maximum peak flow	250% of average flow

Sewage entering the plant is first passed through a 12-in. Parshall flume equipped with an indicating and recording gage located in the control house. From the measuring flume the sewage passes directly through the bar screen, grit chambers, and head-box structure. The bar screen is manually cleaned and provided with a spillway by-pass. The bar spacing provides for $1^1/_4$-in. openings, having a total open area of approximately 500% of the area of the influent sewer line. Screenings are disposed of by burial.

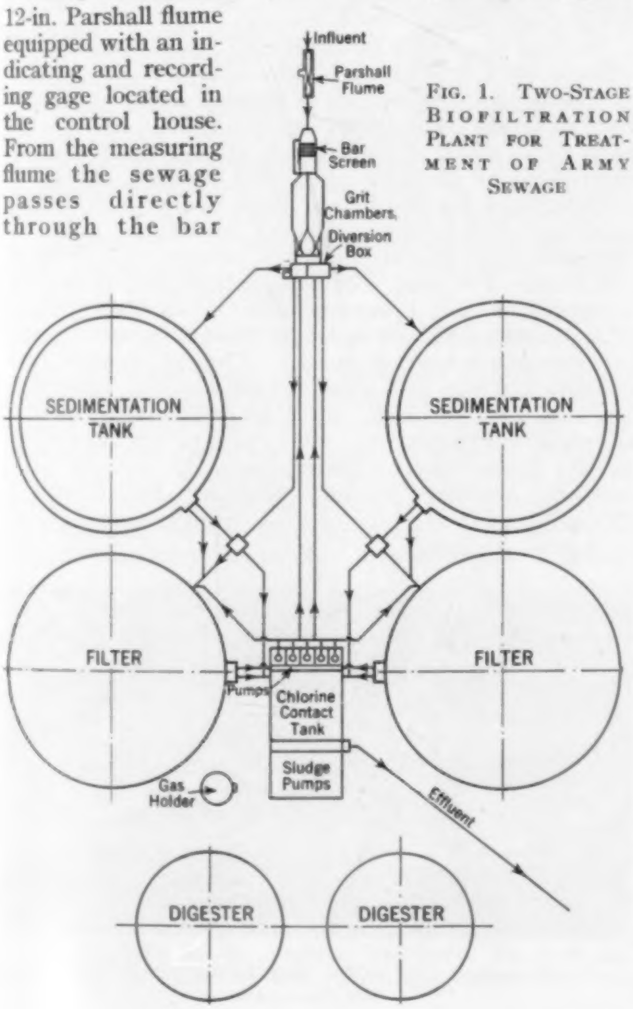


Fig. 1. Two-Stage Biofiltration Plant for Treatment of Army Sewage

Pumps Manifolded for Flexibility of Operation

Duplicate grit chambers are provided. The cross-sectional areas of these chambers and of the narrow throat-discharge sections are such as to produce a constant velocity over the varying ranges of flow. In the original design, a velocity of $^1/_2$ ft per sec was assumed. Subsequent operating conditions indicated that the velocity should be approximately 1 ft per sec, and a change in the throat sections to accomplish this velocity was made.

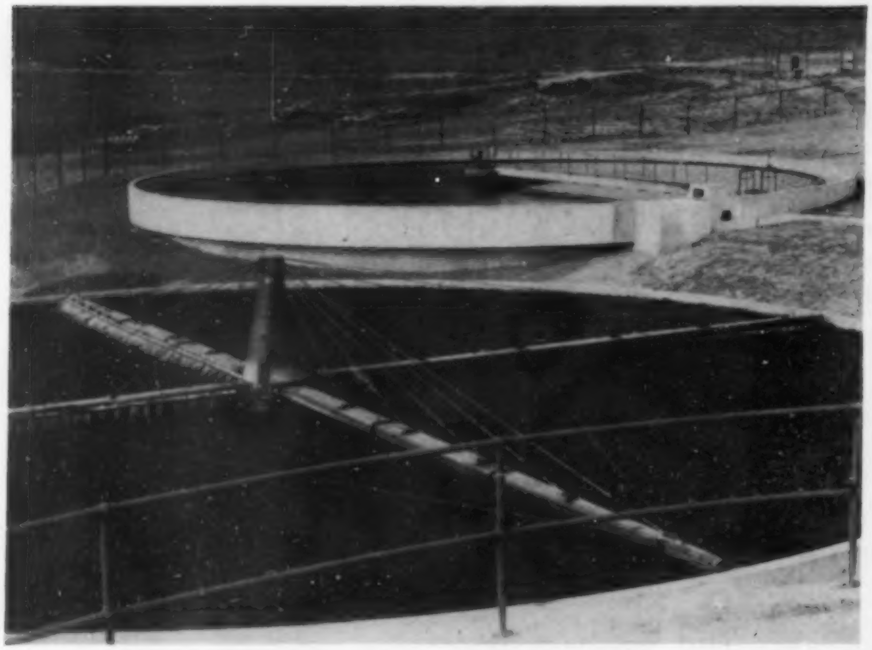
IDENTICAL UNITS USED

Two identical sedimentation basins are provided, either of which may be used as a primary, or as a final. Each is circular in section, 90 ft in diameter, and has a side-wall liquid depth of 12 ft. Each has a peripheral overflow weir, rotating sludge and scum-removal mechanism, and is equipped for splitting the flow when used as a final sedimentation basin. The retention period, based on a recirculation ratio of 1:1 at average flow, is 6.11 hours. The overflow rate of 385 gal per sq ft per 24 hours was dictated by economic considerations, based on the topography of the site and the desire for flexibility.

The two biofilters likewise are identical in design—100 ft in diameter with a depth of rock of 3 ft. Each filter is provided with a rotating sewage distributor of the reaction type, and a ventilated underdrain system consisting of redwood stringers set on low concrete sills. The area of openings is approximately 45% of the total filter-floor area. The size of the filters selected gives a rating of 6.78 mgd, which is equivalent to a population of 32,700 per acre-ft.

Sludge is digested in two reinforced-concrete fixed-dome tanks of the "Hewett" type. Each digester is 60 ft in diameter, with a side-wall liquid depth of 21 ft, and has a conical bottom.

The digesters have a combined capacity of 3.94 cu ft per capita. Sludge gas generated in the digesters is utilized in two gas-fired hot-water boilers with recirculating pump for heating the digesters and for space heating in the control house. Excess sludge gas is burned in a waste gas burner. A floating-dome gas-holder is installed to float on the gas lines. It is interesting to note that three months after the digesters were put in service, sufficient gas was being generated to supply all demands for heating.



SEDIMENTATION BASIN AND TRICKLING FILTERS

In connection with the digesters, the piping is so arranged that they may be operated individually as single-stage units, or together for two-stage operation. The gas and hot-water piping systems have the usual appliances for automatic operation. Meters have been installed at the proper locations to measure the gas production and use.

The control house, which is the heart of any sewage treatment plant, is centrally located between the four major plant units and houses the principal operating equipment. This is a one-story structure with a full-height basement below the ground level. On the ground-floor level are the main recirculating pumps with their connected piping manifolds, the digester heating boilers, space for two one-ton chlorine cylinders, chlorinator equipment, a fully equipped laboratory, toilet and shower facilities for the operators, and an operating room for the control of the sludge-pump operations. The main switchboard for electric power and light is also located at this level.

The recirculating pump pits are at the basement level, directly below the pumps. Under the boiler room, laboratory, and chlorine sections is the chlorine contact tank, while the sludge pumps are directly below the operating room.

PUMPS MANIFOLDED FOR FLEXIBILITY

Five recirculation and service pumps are provided, four normally rated at 1,700 gal per min, and the fifth at 2,600 gal per min. These pumps are of the vertical type, mounted in individual pump pits, powered by variable-speed motors, and automatically controlled by float switches. The influent to the pump pits comes by way of a cross channel with weirs discharging into the pits in such a manner that as the flow increases or decreases, the various pumps automatically start or stop. All five pumps are manifolded to three common headers, with proper valving, to permit the discharge of any pump in either side to the primary sedimentation basin for recirculation, for advance to the second-stage filter unit, or to the final sedimentation basin for recirculation.

Chlorination is provided through two automatic, solution-feed dosing mechanisms. Both machines are rated at 400 lb per 24 hours and are manifolded together for interchangeability. There are six points of application throughout the plant, as follows: influent to each sedimentation basin, influent to each filter, supernatant return to the head diversion box, and the plant effluent.

The volume of chlorine applied to the final effluent is automatically regulated by the flow over a 30-in. weir by means of a float-operated converter. The converter weir is in a channel on the downstream side of the overflow spillway from the chlorine contact chamber. An automatic recorder indicates the chlorine dosage to the plant effluent. The chlorine contact chamber has a retention period of thirty minutes, based on average flow.

Three identical variable-speed sludge pumps are provided. The suctions and discharges of all three are manifolded and equipped with the proper valving to permit any pump to operate to and from any of the points of supply or discharge. The stems of all sludge piping valves are brought up to pedestals in the operating gallery directly above.

All sludge pumps operate with completely flooded suctions. There are three sludge beds, having a total area equivalent to 4.6 sq ft per capita. The beds are in sandy soil and are without underdrains.

In order to provide for additional "polish" to the final effluent, the discharge from the chlorine contact chamber is spread on oxidation ponds located in the low valley bottom lands. The ponds are arranged in five groups, each group covering roughly ten acres. Each group is subdivided by dikes provided with overflow sections.

Designs for the plant were made by Leeds, Hill, Barnard and Jewett of Los Angeles, architect-engineer for the entire cantonment, under the personal supervision of the writer. The plant was constructed by the Fred Early Company of San Francisco under a subcontract with MacDonald and Kahn and J. F. Shea Company, general contractors for the cantonment. The entire cantonment construction was under the direction of Col. Edward S. Bres, M. Am. Soc. C.E., and Capt. Alfred W. Day, both Corps of Engineers, who were successively Area Engineers. Major Ray L. Derby, Assoc. M. Am. Soc. C.E., formerly Assistant Sanitary Engineer, Department of Water and Power, City of Los Angeles, assisted in an advisory capacity.

ARRANGEMENT OF UNITS, WITH OXIDATION PONDS IN THE BACKGROUND

The Alaska Highway—Construction Activities of the Public Roads Administration

By Thomas H. MacDonald, Commissioner of Public Roads

L. I. Hewes, M. Am. Soc. C.E., Chief, Western Region, Public Roads Administration

J. S. Bright, M. Am. Soc. C.E., Alaska Highway District, Public Roads Administration, Edmonton, Canada

A TOTAL of 47 construction contractors were engaged by the Public Roads Administration to work behind the Army troops slashing a military highway through British Columbia, Yukon Territory, and Alaska. Over 7,500 civilians were employed simultaneously on the four major sections of the Public Roads work. This paper was presented at the Society's Annual Meeting, recently held in New York. A symposium in the March issue described the work of the Army on this great highway.

THE Alaska Highway extends approximately 1,480 miles from the railhead at Dawson Creek in British Columbia to the Richardson Highway at Big Delta 90 miles south of Fairbanks. At Fairbanks the extended route meets the Alaska Railroad. There is a branch in Alaska extending 135 miles from the junction of the Tok and Tanana rivers to Gulkana on the Richardson Highway. Later approximately 150 miles of road was added to connect the port of Haines on the Lynn Canal with the main route at a point west of Champagne in Yukon Territory. This makes a grand total of 1,765 miles.

With distances of from 250 to 350 miles between major control airports, and through almost totally unknown terrain, the first task was to reconnoiter the snow-covered country. This job was done jointly by Army and Public Roads engineers. The work began early in March 1942 and proceeded by airplane, dog team, and other ground methods. Available maps were sketchy. Lakes were out of position and critical elevations almost wholly useless. Indicated mountain passes in one area proved to be in error by as much as 3,000 ft. The courses of many rivers of considerable size were largely sketched in. However, there was a corresponding degree of freedom of choice in this wilderness location once the main features of the land began to take form. Right of way was not a problem.

ASSEMBLING ENGINEERS FOR THE WORK

Simultaneously with this work, the Public Roads Administration began to assemble its engineers and to canvass available construction contractors. First, 148 engineers were transferred from its western districts, where National Forest and National Park work largely has been concentrated for many years. Afterward it drew upon its eastern districts, and for field service recruited temporary engineers in considerable numbers from the Far West and Canada. Many of the younger men came from engineering colleges in the United States and Canada. Ultimately, including accountants, purchasing agents and others, 823 Government employees were regularly assigned to the work, and at one period the number reached 1,118. The list included men of the U.S. Public Health Service, who generously and effectively took over the important responsibility of health and sanitation. Their physicians and nurses cared for over 13,000 out-patient treatments, and the doctors performed more than 250 operations.

A district office was scarcely established at Seattle when major problems of transportation of men, equipment, and material arose. Field headquarters were set up at Whitehorse in Yukon Territory, at Fort St. John, and at Gulkana near the Richardson Highway in Alaska. Whitehorse is reached by a narrow-gage railway 111 miles long from Skagway at the head of the Lynn Canal. Vessels from the ports of Seattle, Wash., and Prince Rupert, Canada, reached Skagway by the so-called inland passage.

At Seattle a "management" contractor was secured to handle transportation and camp construction. Owing to war conditions on the west coast it was extremely difficult for him to obtain vessels. Progressively, however, we secured through him 10 tugs and a fleet of towing barges. Later four power cargo vessels were added with a total combined cargo capacity of about 5,000 net tons. In addition five power yachts were chartered to handle personnel. They had a combined capacity of 137 passengers. It is about 480 miles to Skagway from Prince Rupert, and about 980 miles from Seattle. We also had to land men and cargoes at Valdez by a voyage of about 1,500 miles across the Gulf of Alaska. United States Army transports and commercial vessels were also used to move in personnel and equipment. Some were flown directly to Fort St. John, Whitehorse, and Fairbanks by the Yukon-Southern and Pan-American Airways, and by the U.S. Ferry Command.

CONTRACTS ON COST-PLUS-A-FIXED-FEE BASIS

A canvass of interested contractors immediately revealed that no one or small group had control of sufficient equipment. Therefore it was decided to engage the services of management contractors, who in turn would recruit contractors to sign construction contracts with the Government. In the absence of surveys, unit-price contracts were not possible. The four management contractors engaged to cover the total mileage were instructed to recruit contractors on a cost-plus-a-fixed-fee basis. A total of 47 construction contractors were thus engaged.

One Canadian management contractor was obtained, and 10 Canadian construction contractors immediately began the grading of the most southerly 48-mile section between Dawson Creek and Fort St. John, where existing local roads made accessible points on the revised alinement, which was immediately staked out for

Heavy Equipment Was Moved in to the Job Before Spring Thaws Wherever Possible
Reconnaissance Party in Foreground

grading. Another management contractor with 14 Iowa highway construction contractors undertook all the work in Alaska. Many of their 1,400 men were flown into Alaska by the Ferry Command. They set up headquarters at Gulkana on the Richardson Highway. Another management contractor from St. Paul took the

CLEARING WITH A BULLDOZER
Very Little Hand Clearing Was Necessary

section from Fort St. John to Fort Nelson, 256 miles north. From that point to Watson Lake, a distance of 360 miles, the work was assigned to the contractors of the Canadian management contractor. A Seattle contractor took a large part of the 600-mile section between the Alaska–Canadian boundary and Watson Lake.

MOVING IN MEN AND EQUIPMENT—A MAJOR PROBLEM

It will be readily understood that the job of "spotting" the construction contractors along this wilderness route and moving in their equipment was a difficult one. In this operation it was expected that the Army pioneer road would be helpful. Under war conditions the operation assumed formidable aspects. The situation can be realized from a single example. It was necessary to bring into Skagway immediately about 20,000 net tons of freight and shipping and move it thence to Whitehorse over 111 miles of narrow-gage railway, at the time capable of hauling not over 15,000 tons a month. This railway was already overloaded with Army equipment continually arriving at Skagway by transport, where the docks can scarcely accommodate two larger vessels at once.

Before the season was over the various contractors had an aggregate of approximately 7,500 men, all of whom of course had to be housed and fed, and their equipment supplied with gasoline, fuel oil, and lubricants. During a period of approximately five weeks, over 600 carloads of equipment and supplies arrived at the railhead at Dawson Creek. At one time nearly 200 carloads of equipment and supplies were accumulated at Prince Rupert.

Quite early in the season the work of the Civilian Conservation Corps was terminated and its vast supply of camp houses and equipment was largely available for use on the Alaska Highway. The transportation problem thus included the demolition and loading of this material at numerous points. Before the season closed, in addition to a large quantity of construction equipment, several hundred demountable buildings were taken down and reerected all the way from Dawson Creek to Whitehorse, and from Gulkana to the Alaska–Canada boundary. This work is continued through the winter.

As the various reconnoitered sections of the highway were mutually agreed on by the Army Engineers and the Public Roads Administration, survey crews were sent in to locate the line. The organization and dispatching of the many survey crews of about ten men each necessarily continued for several weeks. The accommodations for men at both Fort St. John and Whitehorse at first were so limited that it became necessary, as the flow of men continued, to hustle them out of town to the line positions as rapidly as possible. They and their supplies went by pack train and by airplane to positions spotted at intervals along the route. Many of these parties had no means of communication whatever with their headquarters. Some of them, who went in by airplanes which landed on frozen water, later could not be reached directly by plane, but at intervals their food supplies were dropped from the air and their Indian guides could make contact by painful journeys back to other parties or Army camps.

DESIGN DEVELOPED FROM SURVEY NOTES

As fast as the survey notes developed, they were returned to headquarters for design. The first sections to be designed were necessarily those near headquarters. It was not immediately necessary to determine quantities since the contracts did not involve unit prices. Spotting of culverts and adjustment of profile went on relentlessly. Standard through-truss and deck-truss timber bridge designs were developed in the San Francisco office. Just as designs were completed for various standard span lengths using structural-grade (1,600-lb) timber, complete redesign was necessary using 1,200-lb timber owing to an unexpected shortage in the higher grade. As approximate lengths for pipe culverts of various sizes were developed, they were used as the basis for placing orders, and many thousands of feet, mostly of wood stave pipe, were ordered and shipped in to Dawson Creek, Whitehorse, and Gulkana.

It is to be observed here that during the 1942 season the entire location line survey finally was run. The survey is not yet quite complete, however, on the 150-mile extension to Haines. As the second phase of the construction work developed, it was also necessary to rerun all those portions of the Army pioneer road that are not adjacent to or coincidental with the "L" line previously run. This work also has been developed. The remaining portions of the design work, principally the adjustment of profiles, curvature, and drainage to the Army pioneer road, proceeded this winter in our Western

CHOPPING PERMANENTLY FROZEN GROUND ON THE HIGHWAY IN AUGUST
Insulating Mats of Brush and Gravel Were Placed to Prevent Thawing

District Offices as well as at Whitehorse and Fort St. John.

Up until the first week in August, this initial phase of the Alaska Highway work, namely, reconnaissance and survey and pioneer truck-road construction by the Army, and full standard construction of sections near the Fort St. John, Whitehorse, and Gulkana headquarters by Public Roads, proceeded as previously arranged. On August 8, however, this phase of the work was substantially modified.

This change was caused by a joint directive to use all forces to complete a usable truck road throughout the entire length of the route before the winter freeze. As a result, the work of the construction contractors under the direction of the management contractors of the Public Roads Administration was almost completely rearranged. Their forces were thrown in behind those of the Army on the pioneer road to widen it and otherwise better the roadbed, and above all to place a gravel surfacing.

A Contractor's Force Grading One of the Easier Sections

For practically the entire distance between Dawson Creek and the Sikinni River north of Fort St. John, the subgrade soil is of our A-7 or A-8 classification, or even worse. This is roughly a distance of 175 miles. Tests showed that for this mileage the subgrade contained generally from 80 to 100% of material passing a 200-mesh screen. In combination with flat swampy ground, a worse subgrade soil could scarcely be conceived. The need for surfacing the pioneer road in such sections will be apparent to all highway engineers.

Constructing an Insulating Mat
Borrow Material Was Located in Streambeds

To add to the difficulties, the soil survey parties were unable to discover any usable surfacing material for a hundred miles north of Fort St. John during many weeks of unremitting search. However, after the pioneer road had been put through by the Army and travel became possible, sandstone ledges were discovered. By crushing this material, the threatened long hauls for all forms of surfacing on this 100-mile stretch can be greatly reduced.

To provide surfacing for the pioneer road built by the Army, it was necessary to set up crushing plants as rapidly as possible along sections of the route where other material failed to develop. It was also necessary to order a great many more dump trucks, but deliveries were not prompt.

Except for part of the force of Canadian contractors left on the section south of Fort St. John, practically all the 47 construction contractors began during August to improve and gravel the Army pioneer road. This road now was widened to approximately 20 or 24 ft to provide for two-way travel. A lift of gravel or other surfacing material then was applied, varying in thickness from 4 in. to two or three times that amount, depending on the need and the availability of the surfacing material.

Not only was it necessary to expedite the completion of the Army pioneer road, it was also necessary to construct temporary bridges over the larger streams where the Army crossing had been made by ferry, by ponton bridges, or by other temporary structures. Almost without exception, the new bridges are of the pile trestle type, and the construction contractors, with the Army's help, have finally finished them.

DIFFICULTIES OF BRIDGING NORTHERN RIVERS

It is not expected that many of these bridges will stand up under the spring breakup in April. A number of the rivers, especially on the northern part of the highway, freeze from the banks inward toward the thread of the stream and along the bottom. The channel, thus choked, is unable to carry the flow, which in turn spreads over the banks and tends to inundate the approaches to the bridge. In the spring there are ice jams and of course always a hazard of drifting material. In fact the bridging of the hundred or more streams that cross this highway is a major problem.

Several of the rivers like the Tanana, Lewes (Yukon), Liard, Muskwa, and the Peace are comparable in size to the Missouri or the upper Mississippi. Others flow more directly from glaciers and their action is unpredictable. Summer rains may form lakes on the glaciers that suddenly find outlets and flow under the glacial ice, bringing down volumes of debris. Many streams are very broad and shallow with "braided" channels. When these begin to freeze at the bottom in their lower reaches, the water fans out again and again, piling up ice in a shingle-like pattern across their wide beds. Wild tales of 150-ft ice piles are not, however, corroborated by the 30-ft forest growth along their banks.

Surveys show that this highway ultimately will need about 23,000 lin ft of bridging at an indicated cost of $11,000,000. Last winter we designed some of these spans and began building others. We stockpiled material

TRACTOR USED TO STRING LOGS FOR A TEMPORARY CROSSING CONSTRUCTED FOR THE LEAD CLEARING CREWS

for spring construction at still other sites. The longest bridge of all will be an 1,800-ft suspension bridge across the Peace River south of Fort St. John. It is hoped that this bridge will be finished early in the spring.

CONSTRUCTION DURING THE COMING SEASON

With the first phase of the Alaska Highway now practically completed, it is possible to return to the standard design construction during the coming season. Under the controlled materials priority plan to be operated in the second quarter of this year, there may be an improvement in the delivery of materials. In the past the scarcity of spare parts for trucks and other equipment has been an annoying handicap. Construction during 1943 will have the benfit of a going set-up of repair shops, camp facilities, and overhauled equipment on the ground ready to go. The working season in 1942 was partly consumed in establishing the contractors' forces. The working season of 1943 ought to double the output of the 1942 working season. The designed route following the Army pioneer road will be ready for staking. Seasoned engineering crews will be on the ground as the snow melts. Transportation along the truck road may be somewhat interrupted during the breakup but will be available during the construction season. The days of isolated parties and hazardous conditions are largely behind us.

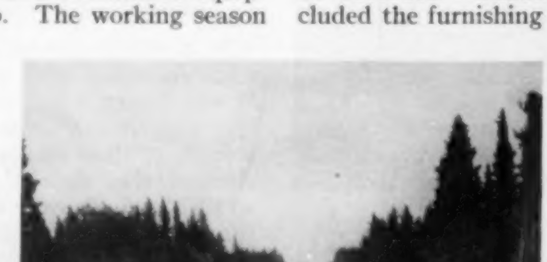
In respect to the cost-plus-a-fixed-fee contracts, our experience has been favorable. The construction contractors have been uniformly efficient. Their agreed wage scales were patterned after the established scales in other going Alaska work for the U.S. Government. Similarly in Canada the Canadian contractors used only Canadians, and we paid their established scale in Canadian dollars. The 47 contractors utilized equipment with a new value of about $10\frac{3}{4}$ million dollars, of which the Government owned 35%. The basic rental rate of the Federal Works Agency was about 27% of the new value plus a 50% rate on second-shift time when actually in use. The Government pays freight, fuel, and repairs, and basic rent from the day of loading to return to the United States on all equipment accepted as ready and available for work.

Average work hours per day varied among the four groups of construction contractors from a low of 10.3 to a high of 11.4. Thus, the overtime above 8 hours ran from 2.3 to 3.4 hours. On this kind of work men seemed willing to work 12 hours a day every day in the week. From June 1 to October 1 practically all the contractors worked from 20 to 22 hours daily in two shifts. For much of this period sunlight was sufficient for carrying on the work.

The cost of the Alaska Highway has not yet been fully determined. The cash outlay by the Public Roads Administration to November 30, 1942, was about $14,000,000 and a somewhat larger amount of encumbrances are on the books. Much of the latter amount is applicable to future construction. Fairly close estimates should be available before the construction season begins.

In particular, much praise is due the fine spirit of the Army officers who commanded engineer troops in the field in the various Engineer regiments. Their cooperation was conspicuous and their persistent efforts against any odds were truly inspiring. The cooperative spirit of the Canadian officials throughout 1942 must also be recorded. Canada's part in the undertaking included the furnishing of all rights of way, the remission of all taxes and duties, and the permission to use all local road-building material. The provincial and national government officials of Canada have cooperated most kindly, and the Royal Canadian Mounted Police also have been alert and forehanded in aiding in many ways.

Nowhere else on the North American continent is there an area comparable in size where a highway could have been projected into such a wilderness, or where comparable transportation difficulties would have been met. Perhaps there never has been a unit of highway of comparable length planned for construction in so short a time. With a reasonable amount of favorable breaks, it is hoped that a standard design road, completed at least to a dry gravel surface throughout the length of the highway and its two branches, may be available before another New Year comes round.



CLEARED SECTION IN THE VICINITY OF FORT ST. JOHN

Stumps and Logs Piled for Burning (This Is Not a Typical Section)

Timber-Concrete Bridge Decks Used in Florida

Continuous Spans Are Featured in Procedure Which Is Economical of Steel

By W. E. Dean, Assoc. M. Am. Soc. C.E.
Assistant Bridge Engineer, State Road Department of Florida, Tallahassee, Fla.

Construction of timber-concrete bridges by the Florida State Road Department has been modified for the purpose of conserving critical materials. The design assumption that the dead load of the floor structure is carried through the continuous spans by the composite section has made possible marked savings in the amount of reinforcing steel required. Construction methods here described by Mr. Dean, include a prestressing of the concrete slab, which also minimizes cracking.

Efforts by the State Road Department of Florida to conserve critical materials have resulted in the modification of several construction details in short-slab bridges. These apply to the conventional timber-concrete composite deck on spans of about 15 to 25 ft. It is composed of a base of laminated timbers of variable depth placed parallel with the center line of the structure, and a thin concrete slab for the wearing surface.

In the usual method of construction, the entire dead load is carried by the timber base. The live load is considered as carried by a hypothetical homogeneous section realized by developing horizontal shear between timber and concrete by means of small steel trapezoids, called "shear developers." These are driven between laminations before the concrete is placed.

Multiple-span structures are usually built continuous, every third timber being broken over the supports and at each quarter point of the span. Negative moment at the supports is resisted by the timber in compression and by the concrete reinforcing in tension. In addition to tensile reinforcing at supports, temperature reinforcing of $^1/_2$-in. round bars at 9-in. centers each way is usually provided. A complete description of this deck, with design premises, appears in publications of the Service Bureau of the American Wood Preservers Association.

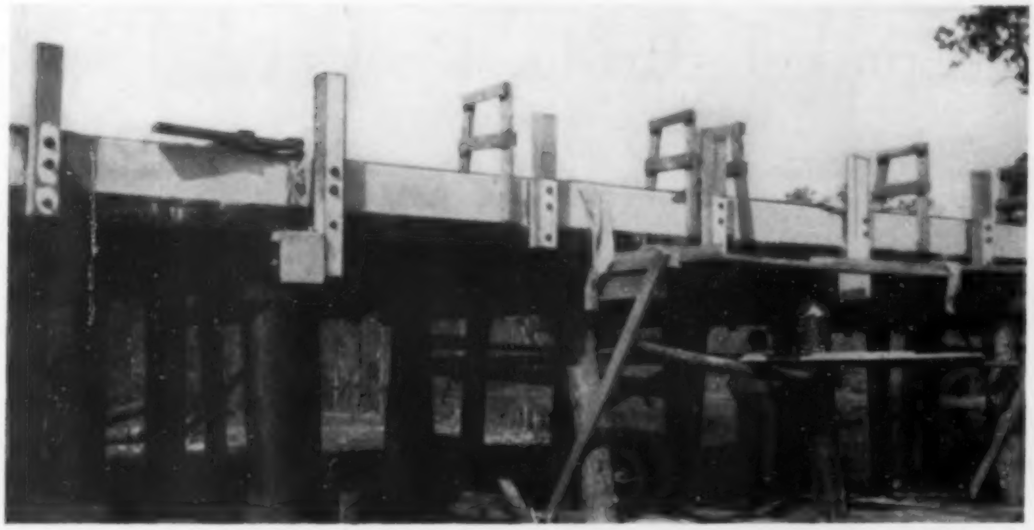
In the usual short-span bridge to which this construction is applicable, the reinforcng described will average about 2.5 lb per sq ft of deck. This weight of steel, while small compared with that in other types of reinforced decks, can still amount to a considerable quantity even in a rather small structure. For instance, a bridge of this type 200 ft long by 24 ft wide would require approximately 12,000 lb of bars in addition to nails, bolts, shear developers, and other hardware. The principal expedients adopted in the Florida construction have been reduction of temperature steel to less than half that generally used, and the placing of construction joints in the concrete at the supports to make possible complete elimination of tensile reinforcing.

There are certain advantages peculiar to continuous construction. Aside from reducing positive moments in the span, it gives more rigidity and a better distribution of bearing to the supporting bent. To retain these advantages, the timbers are placed so that every third timber is broken at the supports and at each quarter point. Any stress analysis of this section is somewhat uncertain as it is impossible to draw any accurate curve of the effective moments of inertia. The lateral distribution of wheel loads is another principal factor of uncertainty. However, a few reasonable assumptions seem to indicate that stresses can be arrived at that will be close enough for all practical purposes.

Another modification has been construction such that the dead load is carried by the composite section. This is accomplished by supporting the timber base at span centers during deck pours and for 21 days thereafter on falsework, thus permitting the composite section to develop before the centers are struck. This procedure has the advantage of reducing dead-load moments at the weak support section to approximately 60% of those that would exist at these points in continuous construction. Another important advantage is that after centers are struck, the concrete slab over most of the span length is under a slight compression because of the positive dead-load moment. This compression should act to minimize cracking due to shrinkage, vibration, reduction of steel, and other forces.

General details of an 18-ft span are shown in Fig. 1. Beam sections (Fig. 2) 1 ft wide are selected on the assumption that horizontal shear between timber and concrete is being fully developed by the shear developers and that the moduli of elasticity are equal for both materials. In these sections each height of lamination is considered as having a width of half the effective timber width at the section.

Timber Concrete Highway Bridge Deck
No Cracks Have Developed in Ten Months of Service



FALSEWORK SUPPORTS USED AT MID-SPAN DURING CONCRETING TO PRE-STRESS THE SLAB

Stress analyses were made on two assumptions regarding the *I* curve (moment of inertia throughout the section). In the first assumption, *I* was considered to increase in a straight-line ratio from the support, through the quarter-point, to the 0.3 point of the span, where it reached the maximum. In the second assumption, *I* at the supports was taken as applying to adjacent lengths of 2 ft, *I* at the quarter points as applying to 1-ft lengths straddling these points, and *I* at mid-span as applying to the rest of the span length. While both of these assumptions are admittedly questionable, it is probable that the actual curve of effective moments of inertia falls between them.

Negative moments at the supports, computed for the two assumptions, are subject to slight variation with various combinations of spans, but are approximately as follows: Case 1, 52% of the simple-span moments for dead load, 27% of maximum simple-span moments for live loads. Case 2, 42% of simple-span moments for dead load, 21% of maximum simple-span moments for live loads. These figures indicate that the support moments could be taken as 50% of the simple-span moments for dead load and 25% for live load without any great error. Maximum positive moments will occur in the end spans. As it is impractical to vary sections between end and intermediate spans, midspan sections should be proportioned for appropriate end-span moments. These moments are recommended as 75% and 90% of the simple-span values for dead load and live load, respectively. This reasoning gives convenient moment factors that can safely be applied to a structure of any number of spans.

It may be supposed that concrete adjacent to supports is stressed in tension. The moment curves, however, show that the inflection points are located fairly close to the ends of the spans. For example, with end moments of half the simple-span values for uniform load, the inflection points for dead-load moment will be located 0.15 of the span length from the support centers. The concrete is, of course, under no stress at the support since construction joints are placed there. The beam length from support to inflection point is simply too short for any appreciable tension to develop. This reasoning has been taken as rank heresy by some who worship the "sacred cow" of so-called "exact analysis," but observation of some actual installations under traffic seems to give reasonable verification of it.

COMPUTATION OF MAXIMUM BENDING STRESSES

Using the moment factors given, the beam sections of Fig. 2, and a 5-ft width laterally for wheel-load distribution (as recommended by the American Wood Preservers Association), the maximum bending stresses are as follows: For H-15 loading, tension and compression of 653 lb per sq in. at mid-span and 1,329 lb per sq in. tension

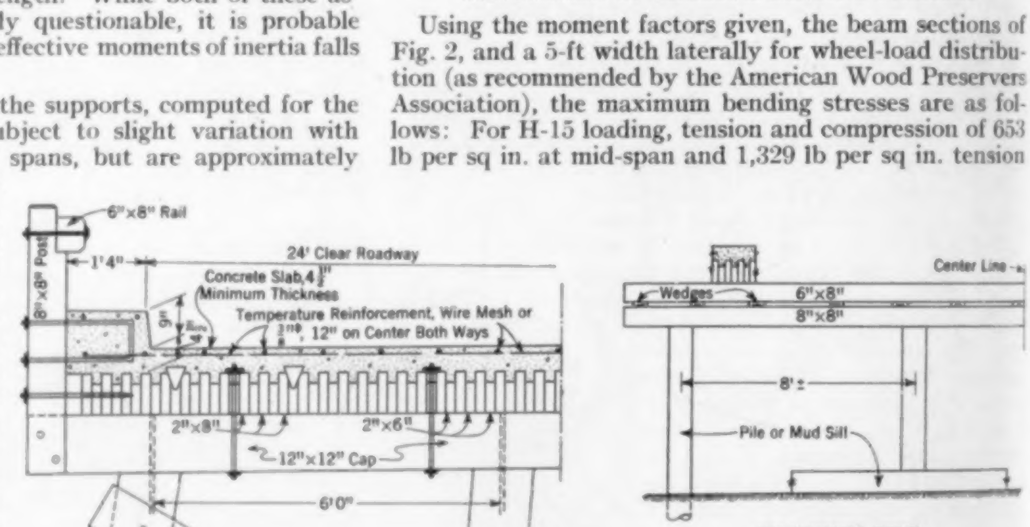


FIG. 1. GENERAL DETAILS OF A TYPICAL SPAN

TIMBER SUB-DECK SHOWING SHEAR DEVELOPERS AND UPLIFT SPIKES IN PLACE

at supports; for H-20 loading, 829 lb per sq in. at midspan and 1,609 at supports. It will be noted that while the stress at the support is the higher, the section there is not critical. In other words, even if a few upper fibers failed, the only harm done would be to increase the positive moments in the span by a slight amount. With this in mind it should be safe to use the common grades of timber with ordinary working stresses of 1,000 to 1,200 lb per sq in., permitting some overstress at the support. The stress at mid-span should properly be limited to the working value for concrete. Under current restrictions on the dense and select grades of structural timbers, use of the common grades appears to be a worthy expedient.

Temperature steel in the concrete slab has been reduced to a minimum. In seven bridges built in various parts of Florida, the only reinforcing used was an obsolete type of highway guard fencing. The wires in this fencing are approximately $^1/_8$ in. in diameter, spaced at 3-ft centers each way. The mesh is spirally woven laterally and completely collapsible longitudinally, so that there is little chance for it to act as true reinforcing. The best that could be expected of this mesh would be the prevention of disintegration in case of severe cracking.

No cracking under traffic has been observed in any of these bridges. The oldest installation, a bridge 198 ft long, was completed in February 1942 and since that time has been under heavy traffic. Inspections of the deck have been made at intervals of about one month, and to date not a single crack has developed. This performance seems to justify the belief that no appreciable tension exists in the concrete adjacent to supports. From this it is judged that a light reinforcing such as is ordinarily used in concrete pavements would be ample for the slab.

TOTAL METAL AT A MINIMUM

Shear computations and spacings for shear developers have been computed as recommended by the Service Bureau of the American Wood Preservers Association, except that dead load has been included in shear computations. This, of course, requires a few more developers than if horizontal shear were computed for live load only. However the weight of metal in these additional developers is negligible. Uplift spikes and nailing of laminated timbers are in accordance with Service Bureau recommendations.

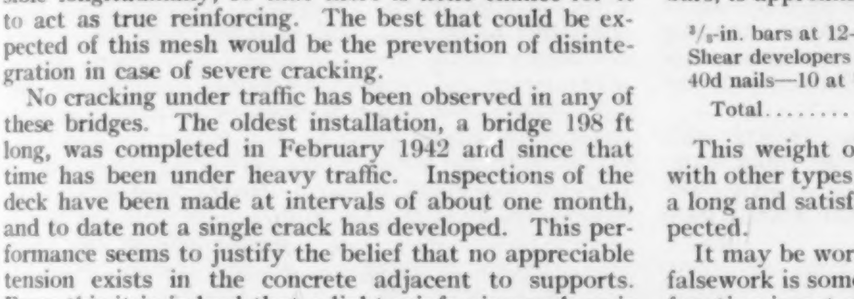


FIG. 2. TYPICAL BEAM SECTIONS FOR 18-FT SPANS

The total weight of metal per square foot of bridge deck, including shear developers, uplift spikes, nails between laminations, and reinforcing with $^3/_8$-in. round bars, is approximately as follows:

$^3/_8$-in. bars at 12-in. centers each way	0.75 lb
Shear developers (average) 3.5 at $^1/_5$ lb	0.70 lb
40d nails—10 at $^1/_{18}$ lb	0.55 lb
Total	2.00 lb

This weight of metal is certainly low in comparison with other types of reinforced-concrete decks from which a long and satisfactory service life can reasonably be expected.

It may be worth while to note that the function of the falsework is somewhat different from the ordinary. This function is not so much to support the span so that objectionable deflections will not occur during construction, as to prevent all downward deflection of the timbers until the span is freed. To attain this end, the falsework must support the entire width of the timber base and should be wedged tightly against the base before concreting is started. Wedging such that the timbers will have a slight initial camber of about $^1/_8$ in. at mid-span is recommended. Falsework loads are light and members need not be heavy, but the support must be uniform and continuous across the width of the roadway if it is to accomplish its purpose. Details of falsework that has proved satisfactory are shown in Fig. 1.

Although the construction described here is believed adequate for any ordinary highway requirements, it is not presented at this time as more than an expedient to conserve critical materials. In the Florida installations, the total cost per lineal foot of bridge has not differed appreciably from the cost of more conventional types. However, in its principal purpose of conserving materials it is successful and therefore its use appears justified. It is probable that a deck like this will have a longer life than a deck composed of timber alone. If it had not been for this design, current restrictions would have made it impossible to use concrete decks at all on the Florida bridges.

Welded Heads for Plate Eyebars

Pin-Connected Tension Members Built Up Economically

By JONATHAN JONES, M. AM. SOC. C.E.
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LARGE quantities of eyebars have continued to be used under special conditions despite the diminishing popularity of this type of connection. The forged-head eyebar, once so widely used for tension members, has for some time been manufactured in but one plant in the country. To provide an economical member for carrying large tensile forces, Mr. Jones describes a section which has been built up by welding. This paper received an award in the recent competition of the James F. Lincoln Arc Welding Foundation of Cleveland, Ohio.

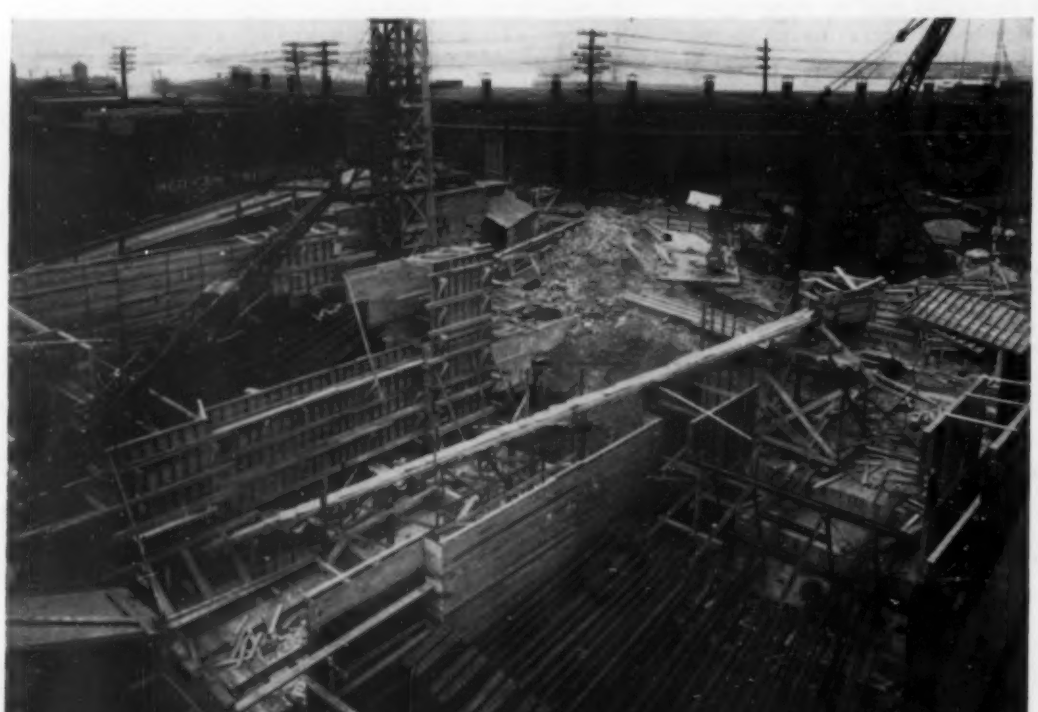
FROM the latter part of the nineteenth century until the recent past, the panel-point connections of American railway and highway bridge trusses, of both short and long spans, were customarily made with cylindrical steel pins, varying from 3 to 16 in. in diameter according to the stresses. These pins were driven, in the field, through close-fitting bored holes near the ends of the several members assembled at a joint.

For reasons of economy the customary form of pin-connected truss members, in the many cases in which the stress to be carried was always tensile, was the forged "eyebar" shown in Fig. 1. To make this bar, a flat bar of steel, of excess length as indicated by the dotted lines at *a* in Fig. 1, was upset hot to form wider heads as at *b*, usually of the same thickness as the original bar. After annealing the full length of the bar, groups of identical bars were stacked and the pin holes were drilled through the stacked group.

The bars most often used ranged from 3 in. wide with 8-in. heads to 16 in. wide with 36-in. heads; the thicknesses ranged from a fraction of an inch to $2^1/_8$ in. Dies for a variety of standard heads, within such a range, were formerly maintained at several bridge shops, but in recent years at only one.

The economy of such a bar lay obviously in the fact that its critical, or least, area for resistance to tensile force was at no point less than that of the main bar. Were the heads to be formed by the riveting on of plates, the section of the main bar would be reduced by the rivet holes, the width of the bar throughout its length would have to be increased by the width of these holes, and the cost would be increased thereby, by more than the cost of forging two heads on the narrower bar.

In recent years the use of these eyebars has diminished, as riveted connections for bridge trusses have grown in favor. Under special conditions, however, they have continued to be used, and in large quantities. These conditions usually are (1) a large tensile force, so that many pieces and considerable money are involved, and (2) a tensile force that is relatively constant, at any rate never approaching release. The reason for the latter condition is that under widely fluctuating stress, such as repeated maximum live-load tension with little dead-load stress, there is a tendency for the bars to cut into the pins, or vice versa, and become objectionably loose.



EYEBARS USED IN THE ANCHORAGE FOR THE CABLES OF THE AMBASSADOR BRIDGE OVER DETROIT RIVER

One typical example of the recent large-scale use of forged eyebars is in the anchorages of suspension bridges, exemplified by that of the Ambassador Bridge shown in the accompanying photograph. The dead-load cable pull in such a bridge being a constant force exceeding that from live load, the situation is ideal for the use of eyebars and pins.

However, in all the modern applications of the pin-connected tension member, the advent of welding has terminated the economical application of the forged-head eyebar. While it might be only a coincidence, still it is a fact that the only remaining eyebar manufacturer in this country

in 1942 announced the scrapping of his dies and the dismantling of his forging equipment, stating that only in sizes 6 in. and under, which have certain special applications, would he thereafter be equipped to manufacture forged eyebars of the classical type.

In 1939 a contract was let for a long-span suspension bridge, requiring in its anchorages 152 eyebars each 50 ft long between pin holes, 12 by $1^7/_8$ in. in cross section, with forged heads 28-in. wide, bored for 10-in. pins. The contractor, Bethlehem Steel Company, however, secured permission to discard this design and to furnish a more modern design of equal strength. In this the 12 by $1^7/_8$-in. (22.5-sq in.) main section was replaced by a wide flat plate of the same area. At each end of this plate, two additional short plates, slightly narrower, were welded on, one on each face, and the pin hole was bored through the triple thickness. This triple thickness, naturally, was the $1^7/_8$ in. of the original design.

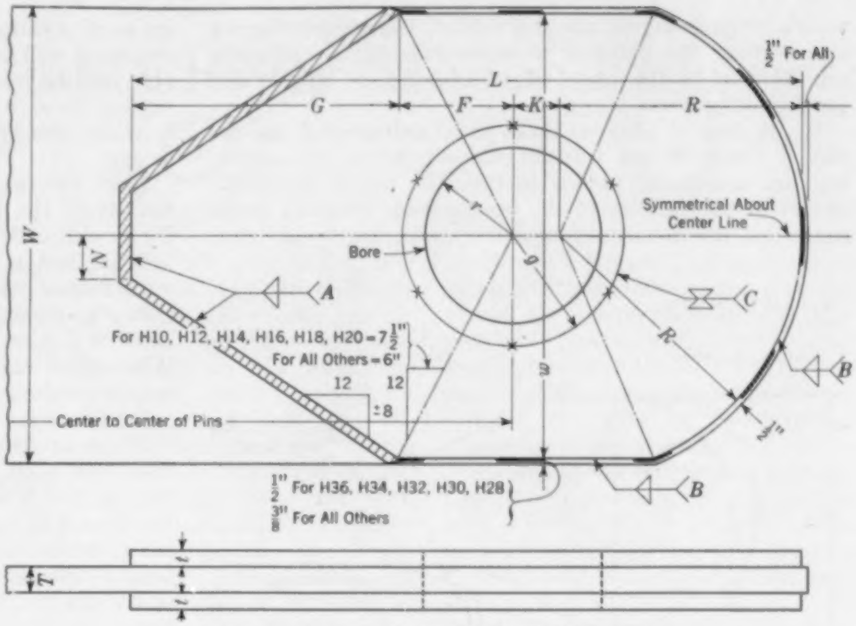


Fig. 2. Welded Head for Plate Eyebar
Recommended Dimensions Are Given in Table I

Thus, before the section of the main plate was reduced by the pin hole, it was relieved of part of its stress, which passed through the edge fillet welds into the pin plates, and at no point in front of, across, or beyond the 10-in. pin hole was there a "critical" section smaller in area than the 22.5 sq in. of the main bar. All the objectives of the forged bar were therefore attained by a less expensive method than forging of the heads—and by a method which is available to any fabricator of bridge work and not limited to such as might have invested in forging dies, infrequently called into use.

The design of this welded head, which was felt to be sound, was "proven in" by a test on a five-eighths linear scale model, which required 535,000 lb (equal to the average coupon strength of the plate material) to break, and which when it broke, did not break through the welded head or show any distress in any of the welding. The actual bars in place in the anchorages of the bridge have been subjected to somewhat more stress than was assumed in the design, and have behaved perfectly.

It may be confidently expected that many tension bars of the wide-plate, welded-pin-plate type, will be required in the future; and the writer, with the results of the design and test just referred to before him, has thought it worth while to prepare a set of improved standard designs for the use of structural engineers. In Fig. 2 is shown the recommended layout for the typical head. It will be noted that:

1. The pin plates are made narrower than the main plate by just enough to allow for fillet welds.
2. The fillet welds opposite and behind the pin are nominal in size, as they do not transfer stress. They may be intermittent for bars which will be protected, such as those that are built into a concrete anchorage; or they may be continuous, minimum-size, sealing welds for exposed structures.
3. The important welds are located in advance of the pin hole, so that the combined resistance of the three plates is in operation before any reduction of area by the pin hole is commenced.
4. The fillet welds placed in advance of the pin hole must develop the same proportion of the total tensile force in the bar as the net area of the two pin plates on a transverse section through the center line of the pin bears to the total net area of the three plates, on that section.
5. The total net section through the center of the pin hole should be about one-third in excess of the area of the main plate. This was true of the forged eyebar heads, and takes care of peak points of bending stress in the head.
6. The total area on a straight, axial line from the back end of the pin to the back end of the head should be about 90% of the area of the main plate. This is more generous than was provided by the standard forged head (about 70%). The danger to be guarded against is that of splitting out behind the pin, the split commencing with a tear in transverse tension at the outer end and progressing inward. In the forged bar, the fibers of the steel received some working in the direction of the transverse tension; in the new type they remain parallel to their original rolling, hence the conservatism in this feature of the new design.
7. A requirement developed by experience is that the total thickness of the three plates should not be less than one-eighth of the net width through the pin-hole, transverse to the axis of the member. With thinner plates there is a danger of "dishing" or "flopping" in the regions behind the pin. (See "Pin-Connected Plate Links," by Bruce Johnston, M. Am. Soc. C.E., Proceedings Am. Soc. C.E., Vol. 104, 1939, p. 314.)
8. The back ends of all three plates are cut on circular arcs, and the center for these arcs is moved somewhat backward from the pin center, thus again preserving the full arcs at all sections reduced by any part of the pin hole. The chosen radii permit the cutting of these rear edges (before assembly, of course)

Fig. 1. Typical Forged Eyebar Head

with a torch swinging about a center, the torch entering and leaving the plate at a reasonable angle, definitely not tangent to the plate edges, making for simple and good-looking cuts.

9. A ring of plug welds is provided around the pin hole. These do not transfer stress between the plates, but are arbitrarily placed to tack the plates firmly together in the vicinity of the boring tool. (In the large-scale test previously referred to, these plug welds gave no indication of distress under the load which broke the main plate in front of the head.)

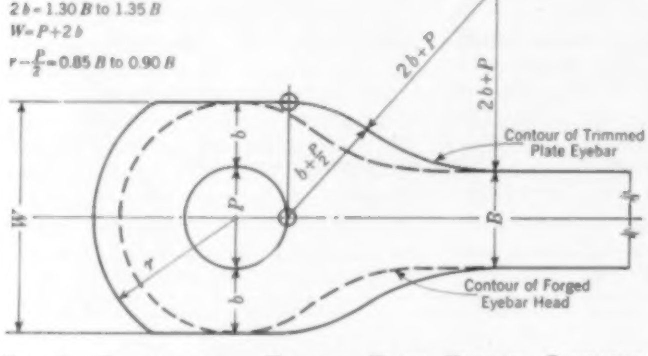


FIG. 3. CONTOUR OF A TRIMMED PLATE EYEBAR, COMPARED WITH THAT OF A FORGED HEAD

In Table I are given recommended dimensions for a selected list of such welded-head bars. This list includes typical cases, condensed from a more comprehensive schedule providing a choice of 62 different net areas, from a maximum of 72.0 sq in. to a minimum of 3.75 sq in., a somewhat wider range than that formerly available in forged-head bars. The complete schedule is on file with the Society, and may be obtained on application to the writer. All the dimensions given conform to the requirements which have been stated in the discussion of Fig. 2.

It is not proposed that these 62 heads become inflexible standards, as the old eyebar heads had to be. The templet cost is so insignificant that it is not to be expected that fabricators will store standard templets, as they formerly had to preserve standard forging dies. Neither is it to be expected that engineers will adhere strictly to the 62 net areas listed, if they can economize substantially by interpolating between two areas that are tabulated.

What is hoped, however, is that the heads thus detailed will prove to be so acceptable from the standpoints of safe design and economical fabrication, that they will become a standard starting point. Then, whether they are used as tabulated, or whether interpolations are made, engineers will have the assurance of economical, dependable tension members just as they did with the old-time eyebar lists, without having for every application to re-study the specifications and devise and test a new design.

If, in the future, when this type of tension member is indicated, the engineers in charge will select from this list or will interpolate closely in it, and then will make a full-size test of a bar or two, as has always been done with forged bars even though they were standardized many years ago, then a feeling of confidence in these heads will soon be established throughout the profession. When that tentative phase is behind us, this schedule can be published in engineering and drafting manuals as a "national standard."

There are two alternative types of bar which in many cases will need to be considered. One of these is a plain flat plate of a single rolled thickness. Its width may be the W of Table I, and its thickness the $T + 2t$ from the same table. This bar becomes competitive when the length between pins is so short that the work of welding on the pin plates costs more than the plain material thereby saved.

The final type is the same as the preceding, except that excess material along the length between pin holes is flame-cut and scraped, leaving a bar resembling in shape the classical forged-head bar. The contour of the head should not, however, be that of the standard forged head as found in manuals, because of the directional properties of flat rolled steel, but should approximate the contour of the full lines of Fig. 3 (in which the dotted line shows the classical forged head). Obviously the criterion as to cutting or not cutting away the superfluous material from pin hole to pin hole will be a comparison between the cost of flame-cutting and such factors as the value of the scrap and the freight from shop to destination.

It would be useless to write equations for the economics of choice between these types. The factors vary from time to time and from job to job. At this writing, for instance, the wartime scarcity of steel plates would be an unusually important factor in favor of the welded head. It is logical to leave the choice to the fabricator, who alone can evaluate all the factors of cost in any given case. The three types can be designed with perfect equivalence, and the choice should be determined by comparative costs. When pound price contracts are in order, the logical procedure is to take a separate price on the bars, of any one design, and then to let the total price determined by the calculated weight thereof be the total contract price, regardless of whether the actual bars are of the heavier or the lighter type.

TABLE I. RECOMMENDED DIMENSIONS FOR A SELECTED LIST OF WELDED-HEAD BARS WITH REFERENCE TO FIG. 2*

Effect. Net Area†	Mark**	Main Bar W	Main Bar T	2-Pin Plates w	t	L	R	K	F	G	N	Pin Diam., $2r$ Min.	Pin Diam., $2r$ Max.	Welding of One-Pin Plate: Fillet Welds A‡		Fillet Welds B§	Plug Welds C	s
72.0	H36,16	36	2	35	1 1/4	52 1/2	19	3 1/2	8 3/4	21 1/4	3 1/2	12	14	57.	13/16	5/16	1 9/16‖	9
51.0	H34,12	34	1 1/2	33	1	49 1/2	18	3 1/4	8 1/4	20	3 1/4	11 1/2	13 1/2	54.	5/8	1/4	1 6/16‖	8 1/2
44.0	H32,11	32	1 3/8	31	15/16	46 1/2	17	3	7 3/4	18 3/4	3	10 1/2	13	51.	9/16	1/4	1 5/16‖	8 1/4
37.5	H30,10	30	1 1/4	29	7/8	43 1/2	16	2 3/4	7 1/4	17 1/2	2 3/4	9 1/2	12	48.	1/2	1/4	1 3/16‖	7 3/4
35.0	H28,10	28	1 1/4	27	7/8	40 1/2	15	2 1/2	6 3/4	16 1/4	2 1/2	9	11 1/2	45.	1/2	1/4	1 3/16‖	7 1/2
29.25	H26,9	26	1 1/8	25 1/4	3/4	38	14	2 1/4	6 5/16	15 7/16	2 1/4	8 1/2	11	42.	7/16	1/4	1 1/16‖	7 1/4
24.0	H24,8	24	1	23 1/4	11/16	35	13	2	5 13/16	14 3/16	2	7 3/4	10	38.	1/2	1/4	1 1/16‖	6 3/4
22.0	H22,8	22	1	21 1/4	3/4	32	12	1 3/4	5 5/16	12 15/16	1 3/4	6 3/4	9 1/2	35.	7/16	1/4	1 1/16‖	6 1/2
17.5	H20,7	20	7/8	19 1/4	11/16	30	11	1 1/2	6	11 1/2	1 5/8	6	9	31 1/2.	7/16	1/4	1 1/16‖	6 1/4
13.5	H18,6	18	3/4	17 1/4	5/8	27	10	1 1/4	5 3/8	10 3/8	1 1/2	5 1/2	8 1/4	28 1/2.	3/8	1/4	15/16¶	6
10.0	H16,5	16	5/8	15 1/4	1/2	24	9	1	4 3/4	9 1/4	1 3/8	4 3/4	7 1/2	25.	5/16	1/4	13/16¶	5 1/2
7.0	H14,4	14	1/2	13 1/4	7/16	21	8	3/4	4 1/8	8 1/8	1 1/4	4	6 1/2	22.	1/4	3/16	13/16¶	5
5.25	H12,3 1/2	12	7/16	11 1/4	3/8	18	7	1/2	3 1/2	7	1 1/8	3 1/2	5 1/2	18.	1/4	3/16	13/16¶	4 1/2
3.75	H10,3	10	3/8	9 1/4	5/16	15	6	1/4	2 7/8	5 7/8	1	3	4 1/2	15.	3/16	3/16	13/16¶	4

* In inches, except where shown. † Sq in. ‡ Appropriate length of continuous weld, and leg size of weld. § Leg size of intermittent welds 4 in. long, 12 in. on centers. ‖ 6 Plugs. ¶ 4 Plugs. ** Composed of two numbers defining the main bar: (1) its width, (2) number of eighths in its thickness.

Preserving Columbia River Salmon Fisheries

Controlled Migration Creates New Spawning Grounds

By Dirk A. Dedel, Assoc. M. Am. Soc. C.E.
Engineer, Bureau of Reclamation, Denver, Colo.

Construction of Grand Coulee Dam threatened the Columbia River fisheries with considerable losses because of the spawning habits of the salmon. The height of the dam, the irrigation pumping, and the long stretch of impounded water imposed great obstacles to migration to the upper reaches of the river, not to mention the impossibility of getting the young fish back downstream. Induced migration to other branches of the river provided aid for the threatened industry. The planning and operation of the hatcheries, as described by Mr. Dedel, make a fascinating story.

Fishery development along the Columbia River has a long and varied history. Even before the advent of the white man the Indians, who numbered some 50,000, according to explorers made the salmon a substantial part of their daily diet. The white settlers soon discovered its importance as a food, both for immediate consumption and for trading purposes. The first canning plant was established on the Columbia River at Eagle Cliff, Wash., by the firm of Hapgood, Hume and Company, which put up 4,000 cases of fish in 1866.

The industry grew rapidly, and in 1883 thirty-nine canneries were in operation. At present it is not uncommon for one cannery to turn out from 2,500 to 4,000 cases in one day. Since 1866 over 2 billion pounds of salmon have been produced by the Columbia River fisheries, which is an average of 27 million pounds a year. From these figures it can be seen that salmon production is a major industry in this country.

Besides constituting an important source of protein food, the fisheries of Washington and Oregon supply many by-products which are of great economic importance to the region. For example, they supply fish meal which is used as poultry food, salmon oils which contain an important source of vitamin D, and other fish oils used extensively in the manufacture of shortening, soaps, insect sprays, paints, and varnishes. All these products are obviously dependent upon the available supply of raw materials. Thus it is clear that the Columbia's fisheries are of far-reaching importance to the nation. It was therefore necessary to initiate a program of salmon conservation when the construction of Grand Coulee Dam interfered with the upstream migration and natural spawning of the fish in the tributaries above.

The most important species of salmon on the Columbia River are the chinook or king, the blueback or sockeye, and the silver. The steelhead trout, often considered by fishermen to be a salmon, is another migratory fish of commercial importance.

All the salmon are anadromous fish, that is, they spend the greater part of their lives feeding in the ocean but invariably enter fresh water to spawn. They grow rapidly in the sea, and in from 4 to 6 years attain full growth and maturity. At this time they are impelled by instinct to return to fresh water, seeking the stream from which they originally began the journey to the ocean, no matter how widely they may have strayed during the several years of ocean residence. During the ascent of the rivers the adult fish do not eat, but live on fat stored during their long ocean sojourn.

So strong is this homing instinct that migratory salmon will seldom seek other spawning grounds which may be accessible when the way to their natural spawning area is barred. Rather, they will exhaust themselves to the point of death in a futile effort to leap whatever barrier is interposed.

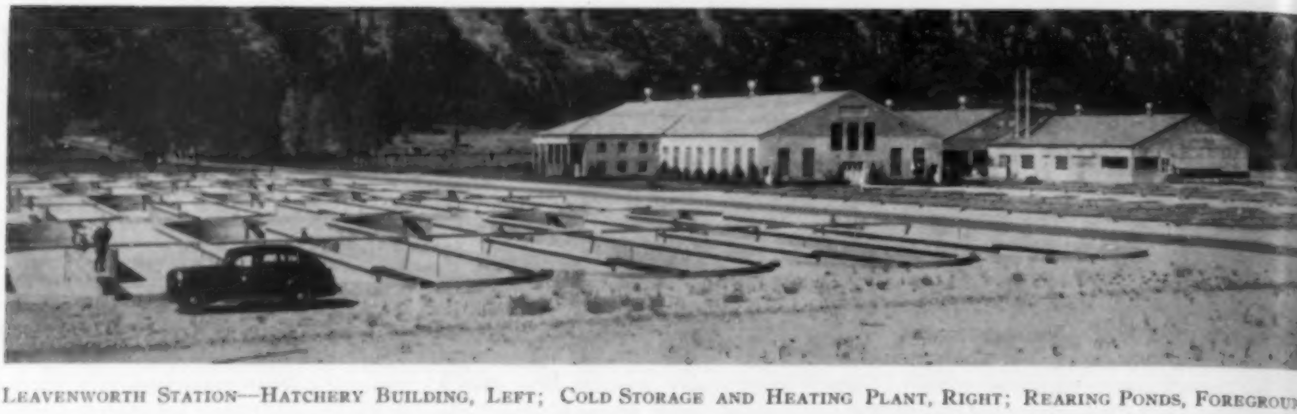
It is possible to take advantage of this homing instinct by transplanting the eggs or young fish to streams where it is desired to establish a run, since the salmon, under favorable conditions, will return to the stream where they were liberated rather than to the stream from which the eggs were taken. It is on this fact that the scheme for the salvage of the migratory fish industry of the Upper Columbia River is based.

Former Spawning Grounds Isolated by Construction of Grand Coulee Dam

The building of Grand Coulee Dam, with its height of 370 ft above normal tailwater, created a serious problem. On account of the great height, ordinary fish ladders were not considered feasible. If the adult salmon, reaching the base of Grand Coulee Dam, were transported across the dam by some feasible means, it is doubtful if the chinook and steelhead would continue to travel upstream to the tributaries through the comparatively still waters of the lake created by the dam, since their natural instinct is to swim against the current of a moving stream.

A much greater problem arises when, in the spring of the year, the young fish begin their downstream migration. It being utterly impossible by any known method to collect them at a central point for handling, only three methods of passing the dam are open to them—over the spillway, through the outlets, or through the penstocks and turbines. If they pass over the spillway they must not only survive the 370-ft drop down the face of the dam, but they also must emerge safely from the turbulence in the bucket at its base. There is some question whether the young fish would sound deeply enough to find either the outlet or the penstock entrances; but assuming that they did, the sudden change of

Fish Truck Being Loaded at Rock Island Dam
Elevator Tank Is Filled at Trap in Fish Ladder



LEAVENWORTH STATION—HATCHERY BUILDING, LEFT; COLD STORAGE AND HEATING PLANT, RIGHT; REARING PONDS, FOREGROUND

pressure incident to passing through these openings would inevitably result in heavy mortality.

In the spring, the irrigation pumps will draw 18,000 cu ft per sec of water from behind the dam, and it would be practically impossible to screen the intakes with a mesh sufficiently fine to keep out the young fish. If no screen were provided, large numbers would be pumped into the irrigation system to perish. All these problems make it impracticable either to put the adult fish over the dam or to get the young fish safely past it on their way back to the sea.

CREATION OF NEW SPAWNING GROUNDS

As a result of an investigation by the Bureau of Reclamation, U.S. Department of the Interior, in cooperation with the Department of Fisheries of the State of Washington and the U.S. Bureau of Fisheries, the following four-point plan of fish protection was adopted:

1. Trapping of adult fish ascending the Columbia River at the existing ladders in the Rock Island Dam built by the Puget Sound Power and Light Company near Wenatchee, Wash., about 150 miles downstream from Grand Coulee.

2. Transference of these fish to holding ponds on Icicle Creek, a tributary of the Wenatchee River, for retention during the "ripening" period, until they are ready to spawn.

3. Construction of a main fish cultural plant on Icicle Creek near Leavenworth, Wash., and of auxiliary hatching and rearing stations on the Entiat and Methow rivers, each station having adequate water supplies with respect to both quantity and temperature.

4. Artificial hatching and rearing of the young fish and their liberation in the tributaries of the Columbia River between the Rock Island and the Grand Coulee dam.

In each of the three existing fish ladders at the Rock Island Dam a fish trap was built for the purpose of catching the salmon and preventing them from continuing upstream toward Grand Coulee Dam. The fish enter the trap through V-shaped entrances leading into a holding pool. When a sufficient number have accumulated in this pool, a movable picket bottom crowds them into an adjoining enclosure directly above a steel tank. This tank with its picket superstructure to prevent the fish from jumping out, is then hoisted above the level of the approaches and roadway of the dam. With the tank in its raised position, a chute in the side allows the discharge of fish and water into a specially designed fish truck for transportation to the holding ponds at Leavenworth Station.

The fish truck has a steel tank with a capacity of 1,000 gal, an aerating system to replenish the oxygen in the water, and an ice compartment to control the temperature of the water. The water is cooled not only to avoid any rise in temperature during the trip, but also to avoid the sudden change of about 10° between the river water and the water in the holding ponds.

Leavenworth Station, the main fish culture plant of the entire project, is near the town of Leavenworth, Wash., at the junction of Icicle Creek and the Wenatchee River, approximately 35 miles northwest of the Rock Island Dam. Here a series of three holding ponds were constructed. It is necessary for the chinook and steelhead to have a certain strength of current to fight against to use up the stored energy accumulated for the upstream migration and to complete the physiological processes of "ripening." This process is not complete when the adult fish reaches the Rock Island Dam, and a period of several months may pass before the fish are ready to spawn.

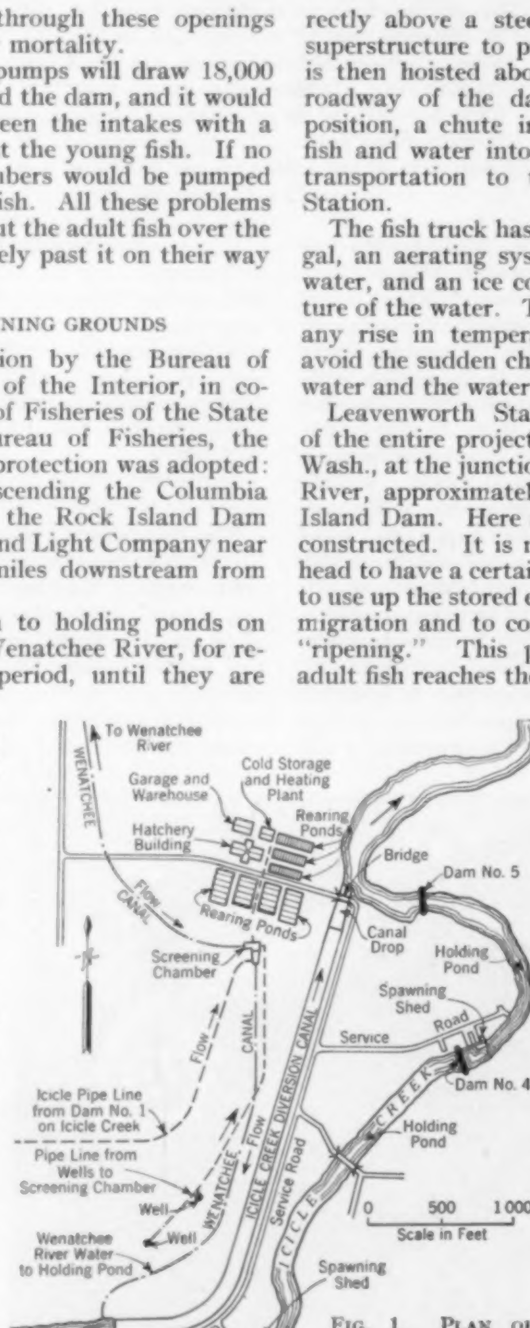


FIG. 1. PLAN OF LEAVENWORTH STATION

In order to duplicate as nearly as possible a natural environment during this period, low concrete weirs were built across the natural channel of Icicle Creek, and these form holding ponds for the fish. When the adults are ready for spawning they are caught in nets; the eggs are removed and placed in the spawning sheds located on the bank of each pond, for cleaning, sorting, and hardening, after which they are transported to the hatchery. All the adults, except the steelhead, which spawn more than once, are killed when the eggs are taken, and the carcasses are used as food for the young fish.

The main hatchery building is 225 ft long by 88 ft wide, with two wings each 36 by 45 ft in area, used as office and laboratory space. The building has a steel frame with reinforced-concrete walls and

floor. On the main hatchery floor rest four rows of 72 concrete troughs, each 16 ft long, $16^1/_2$ in. wide, and 16 in. deep. Stacks of shallow trays containing the eggs are placed in these troughs and remain there during the incubation period. A constant supply of cool water flows through each trough and is carried away through a system of floor drains.

The eggs will hatch in about $2^1/_2$ months, the exact time being controlled by the temperature at which the water is held, but the young fish remain in the hatchery troughs for another four months while they absorb the yolk sac from which they receive their early food supply. At the end of this period they are transferred to the rearing ponds.

These ponds, adjacent to the hatchery building, are of reinforced concrete built flush with the ground. Thirty large pools, each 130 ft long, 29 ft wide, and $5^1/_2$ ft deep, and 40 small pools, each 76 ft long, 17 ft wide, and 4 ft 4 in. deep, retain the fish until they have matured sufficiently to be liberated in the nearby streams whence they find their own way to the ocean.

A concrete division wall, placed on the longitudinal center line of each pond and terminating about 10 ft from each end, divides the pond into two channels. A constant supply of water—675 gal per min for the large ponds and 450 gal per min for the small ponds—is sprayed into the ponds through a 4 or 6-in. pipe laid across the top, coinciding with the transverse center line. The water passes through a line of small holes drilled normal to the center line of the pipe and pointed downward at a 45-deg angle. The sprays point in opposite directions on each side of the division wall, thus creating a circulatory motion throughout the entire pool. The supply and drainage piping is so arranged that the number of ponds in use may be varied as desired.

In addition to the main hatchery building, station buildings include a garage and warehouse, and a cold storage and heating plant. The garage and warehouse provides facilities for storing, repairing, and servicing the fish trucks, a space for general storage, and such shops as are required for maintenance. The cold storage and heating plant contains a complete refrigeration plant for storing fish food and carcasses and for the manufacture of ice used in the fish trucks, and the central heating plant, for all the buildings at the station.

Water flowing through the holding ponds is supplied from the natural flow of Icicle Creek, and the quantity is controlled by Dam No. 2 (Fig. 1), which has two 16 by 5-ft radial gates. The normal quantity required during the spawning season is 200 cu ft per sec. A maximum of 1000 cu ft per sec can be passed during the spring runoff, for cleaning and freshening the ponds before the next season's use. The diversion canal, with a maximum capacity of 10,000 cu ft per sec, will by-pass all the excess water not required for the holding ponds and deliver it 500 ft downstream.

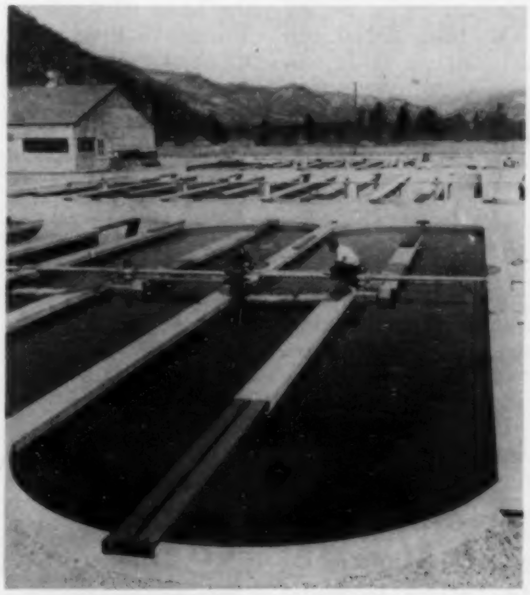
Water for the hatchery and rearing ponds is obtained from three sources—Icicle Creek, the Wenatchee River, and wells located on the west side of the

Hatchery Building at Leavenworth Station Shows Effectiveness of Simple Concrete Walls and Columns

diversion canal. The Icicle Creek water is diverted into the pipe line at Dam No. 1 approximately three quarters of a mile upstream from the holding ponds. The pipe is a 28 and 24-in. continuous wood-stave pipe with a designed capacity of 31 cu ft per sec, of which 12 cu ft per sec is diverted to satisfy irrigation rights. Untreated staves are used, creosote or other preservatives being said to be toxic to the fish. The Wenatchee Canal has its intake on the Wenatchee River approximately two miles north of Leavenworth Station and has a designed capacity of 155 cu ft per sec. Of this amount, 71.5 is used for the hatchery and rearing ponds; the rest supplies the holding ponds when the Icicle Creek supply is insufficient.

Provisions for Cold Water Supply

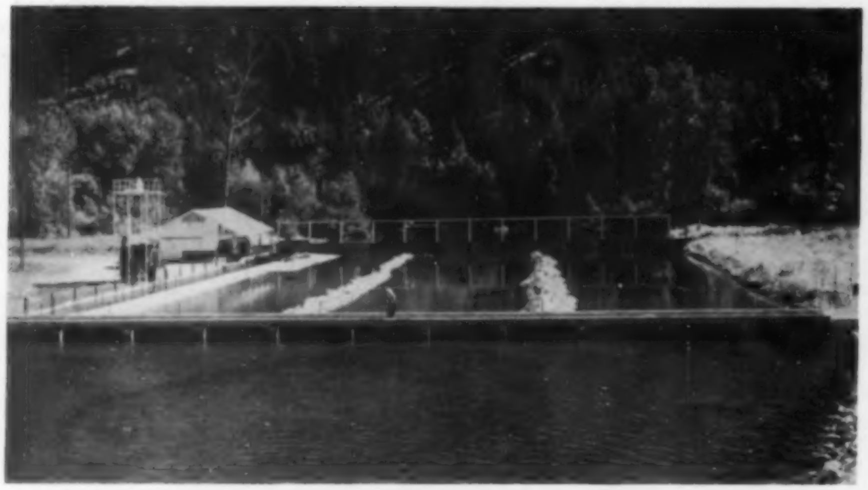
Normally, the water from Icicle Creek and the Wenatchee River will be of satisfactory temperature for spring and fall operations in the hatchery building, but when it becomes too warm, well water at 50 F may be used to reduce the temperature. During the winter the addition of well water to 33 F Icicle water will make a 40 F temperature in the hatchery troughs feasible, and the addition of well water to the rearing pond supply will prevent the formation of ice.



Concrete Rearing Ponds at Leavenworth Station Showing Method of Spraying Fresh Water Into Them

The Icicle pipe line and the Wenatchee Canal enter a screen chamber just south of the hatchery building, where a series of screens remove the trash and where provisions are made to mix the proper quantities of cold Icicle Creek water and the comparatively warm Wenatchee River water.

During the latter part of each summer the temperature of the Wenatchee River becomes too high for successful holding-pond operation and the flow in Icicle Creek is reduced, owing to the irrigation demands and the natural decrease in runoff, so that the supply of cold water is inadequate for holding-pond operations. A supplementary storage supply has been developed from an isolated and undeveloped region on the headwaters of Snow Creek, a tributary of Icicle Creek, about seven



ICICLE CREEK HOLDING POND AND SPAWNING BED
Spawning Shed and Truck-Loading Device May Be Seen at Left

miles from Leavenworth Station and at an elevation nearly one mile above it. Snow Creek has its origin in Snow Lake, which is separated by a narrow granite ridge from another smaller lake called Nada Lake, located about 470 ft below and to the north, the outlet of which discharges into Snow Creek.

A 5 by 7-ft tunnel was driven through the granite ridge separating the two lakes, to enter Snow Lake about 150 ft below the surface, making approximately 12,000 acre-ft of natural storage available. The tunnel was excavated upward toward the lake at an 0.01 slope for a distance of 2,500 ft. As the tunnel heading approached the lake, "feeler" holes were drilled upward and ahead of the heading to determine the thickness of the rock separating it from the lake bottom. When this thickness had been reduced to about 20 ft, an inclined tunnel section was started upward from the main bore on an angle of 57° 30′ with the horizontal, and continued until only a 7-ft thickness remained. This last 7 ft of rock was then drilled with 32 holes to receive a total of 220 lb of 60% gelatin dynamite for the last shot, thus connecting the lake and the tunnel.

Before this last shot was fired, an outlet works was installed about 150 ft from the downstream portal, which consists of a concrete bulkhead 7 ft 4 in. thick keyed into the granite side walls of the tunnel, with a 30-in. diameter plate-steel pipe through the bulkhead connecting to a 30-in. cast-steel gate valve for emergency purposes, and a $28^1/_4$-in. tube valve for regulating purposes. Following the installation of the outlet pipe and the 30-in. gate valve, the final shot was fired with the gate valve closed, after which the installation of the $28^1/_4$-in. tube valve was completed.

Access to the site from which the tunnel was driven presented a serious transportation problem, as the portal was six miles from the nearest road and more than 5,000 ft higher than Leavenworth Station. Besides, the construction had to be done during the winter months, as the water from Snow Lake would be needed the following summer. Under contract with the Bureau of Reclamation, the Forest Service built six miles of 30-in. trail, which required $1^1/_2$ months for completion. Bids were considered on transportation of equipment, supplies, and materials by airplane and by pack train. The contract was awarded for transportation by pack train and the contractor, with 50 to 100 horses, carried in nearly 500,000 lb of food, camp equipment, engines, gasoline, air compressors, drill steel, and construction materials.

Two auxiliary hatchery stations have been constructed which are similar in operation and layout to the Leavenworth Station except that no provision is made for holding the adult fish or taking the eggs. These stations will receive partially developed or eyed eggs from Leavenworth Station for subsequent hatching and rearing, as the eyed eggs can be transported with less mortality and considerably less expense than can the fish in any other stage of its life.

Entiat Station is on the Entiat River about 35 miles north of Rock Island Dam; and Winthrop Station, on the Methow River, is about 85 miles north of this dam. Each of these stations will have a hatchery building, part of which will be used as cold storage, heating plant, and garage space; rearing ponds the same size as the Leavenworth ponds; and a complete water-supply and drainage system, including provisions for screening and tempering the water.

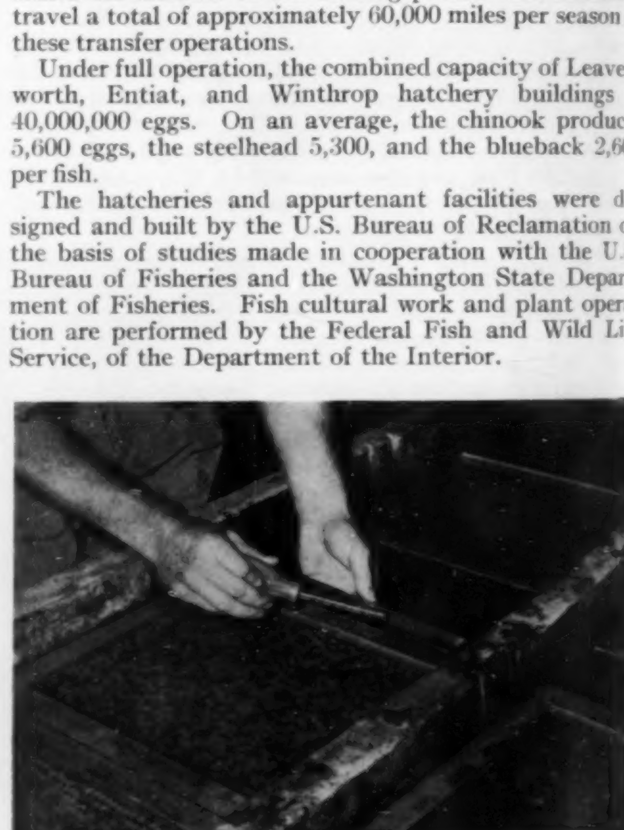
There is also the Chamokane Hatchery, near Spokane, Wash., which provides game fish to stock the reservoir and tributaries upstream of Grand Coulee Dam.

A FEW STATISTICS

A 10-year average of approximately 8,000 chinooks, 3,300 steelheads, and 17,000 bluebacks has been counted through the fish ladders at Rock Island Dam, and during the 1942 season about 6,500 chinooks, 1,700 steelheads, and 16,000 bluebacks were caught and placed in the fish trucks for transfer to the holding ponds. Seven trucks travel a total of approximately 60,000 miles per season in these transfer operations.

Under full operation, the combined capacity of Leavenworth, Entiat, and Winthrop hatchery buildings is 40,000,000 eggs. On an average, the chinook produces 5,600 eggs, the steelhead 5,300, and the blueback 2,600 per fish.

The hatcheries and appurtenant facilities were designed and built by the U.S. Bureau of Reclamation on the basis of studies made in cooperation with the U.S. Bureau of Fisheries and the Washington State Department of Fisheries. Fish cultural work and plant operation are performed by the Federal Fish and Wild Life Service, of the Department of the Interior.



SORTING AND COUNTING EGGS IN A HATCHERY TROUGH

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments on Economy Method of Computing Steel Design

To the Editor: The paper by Odd Albert, entitled "Economy Method of Computing Steel for Reinforced Concrete Columns," in the February issue, represents a definite step forward in our knowledge of this method and our ability to design more efficiently. The writer has suggested to several of his co-workers in recent years that such a method should be developed and is therefore especially interested in Professor Albert's article with its graphical representation of the results.

When a designer attempts to design a reinforced concrete member, subject to thrust and bending, in accord with the 1940 Joint Committee Code, he encounters two difficulties that might well be taken into account in future research on this problem. First, a minimum value is often set upon the compressive steel area by the code requirement that a certain fraction of tensile steel must be carried into adjacent compressive regions for embedment. If the compressive steel thus required exceeds the value given by Professor Albert's method, a minimum of total steel may be obtained by allowing the compressive concrete stress to go below the allowable value. Second, the code presents a formula for the allowable compressive stress with thrust and bending based on a reasonable premise. Although a few designers have discovered the formula, fewer are using it and fewer still have discovered its premise. The allowable stress varies with the eccentricity of the thrust and with the flexural properties of the section. Thus it may be seen that the use of Professor Albert's graph in accord with the code would present a lengthy trial-and-error problem, in which the allowable compressive stress would first be assumed and then checked by the code formula after the steel had been determined. This method of solution would still be in need of further research, since the differentiation of the total steel area has been performed, assuming f_c to be a constant.

The writer would like to point out that, by using the example illustrated by Professor Albert, it can be shown that a reduction of 10% in the allowable compressive stress results in an increase of more than 20% in the total steel required. This shows the inadvisability of lowering the allowable fiber stress in concrete from $0.45f_c'$ to $0.35f_c'$, as has been done in the War Emergency Specifications issued by the government.

Stanley U. Benscoter, Jun. Am. Soc. C.E.
Associate Engineer, The Engineer Board, Bridge Section

Fort Belvoir, Va.

Commissions in Sanitary Corps of the Army

To the Editor: Reference is made to the article entitled "In Pursuit of a Military Commission," which appeard on page 155 of the March issue.

In order to correct any false impressions relative to the need of sanitary engineers in the Army, I wish to advise you that the Sanitary Corps now consists of approximately 300 sanitary engineers and is anticipating a need for 500 additional sanitary engineers before the end of the year. At the present time the Sanitary Corps is commissioning about 40 engineers each month.

The qualifications for appointment in the Sanitary Corps are that the applicant must possess a college degree in engineering and shall have had at least four years of experience in sanitary engineering work.

The writer of the letter does not state whether he meets these requirements. If you will have him write to me, I will be glad to review his application with a view to offering him a commission in the Sanitary Corps.

With reference to the forms which are necessary in order to file an application, I believe your correspondent has counted all the carbon copies and letters of recommendation that he must procure. In view of the fact that this office must recommend applicants for commissions without having the opportunity of interviewing them, it is not believed that the number of application forms is excessive.

J. J. Gilbert, Assoc. M. Am. Soc. C.E.
Major, Sanitary Corps; Office of Surgeon General

Washington, D.C.

Methods of Estimating Flood Frequencies

To the Editor: The article by Ralph W. Powell on "A Simple Method of Estimating Flood Frequency," in the February issue, is a valuable contribution. It gives the profession a new and useful tool for the analysis of flood-flow data and makes the use of Gumbel's basic theory practicable. I am sure that engineers will now use this method for some streams, and it is to be hoped that graph paper of the type used in Professor Powell's Fig. 1 will be manufactured and sold.

In comparing the method proposed by Professor Powell with that of Allen Hazen, as presented in his book *Flood Flows* (published by John Wiley & Sons), I find that Hazen's method, being more flexible, gives a much closer agreement with actual flood-flow data for a large number of individual streams which he has analyzed. To illustrate this point, when the frequency distribution used by Professor Powell is plotted on Hazen's logarithmic probability paper, the lines become straight at a value of the coefficient of variation of about 0.35. They are concaved upward for lesser values of his coefficient and concaved downward for greater values of his coefficient. The lines for lower values of the coefficient are not far from straight. Thus the data for the Connecticut River in Professor Powell's article, which has a coefficient of variation of about 0.3, plot also as an approximately straight line on Mr. Hazen's paper.

Of the curves of actual data for fifteen streams shown in Mr. Hazen's book (pages 75 to 85), with the coefficients of variation of more than 0.35, ten are concaved upward and only five are concaved downward, as required by Professor Powell's function. The reason why these actual curves of flood frequencies presented by Mr. Hazen do not follow the function used by Professor Powell may be that in each case the record of time covered by the curve is too short. In any case, I do not offer this fact as evidence of the incorrectness of Professor Powell's function, but merely to show that other functions may be more closely in agreement with actual data now available for many individual streams.

It may be significant that Mr. Hazen's "average" curves for the various sections of the country do show, for the larger values of the coefficient of variation, the same general shape that is concaved downward, called for by the probability function proposed by Professor Powell. Again, may I express my opinion that the probability function, presented by Professor Powell so skillfully and conveniently, will prove of value?

W. E. Howland, Assoc. M. Am. Soc. C.E.
Professor of Sanitary Engineering Purdue University

Lafayette, Ind.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

During the past several months Dr. Mead has been answering questions on engineering ethics in these columns. Herewith Dr. Mead gives his answer to Question No. 7, which was announced in the February issue. This question states that, "In a certain large corporation which employs many men, it is the practice of the superintendent and other officials of the company to have their automobiles overhauled and repaired at the company's repair shop, and to have more or less work done at their homes by the company's men and on the company's time. Should it be considered bad practice if the workmen made small tools and other things for themselves on the company's time and from the company's material?"

Question No. 7 must be regarded as somewhat naïve, since the explanatory prologue on which the question is based seems to assume that the conditions stated therein are ethical and not questionable. As a matter of fact, the conditions stated are entirely unethical and might be regarded as criminal. No official of a corporation has any right to incur any expense that the corporation must pay unless such expense is allowed by the board of direction in a fairly definite amount and as a part of his compensation for service. If such services are incurred without action of the directors it must be regarded as either pilfering or stealing in accordance with the amount of expense involved. It therefore follows that any work done by a company employee for benefit to himself or anyone except the corporation itself, and in which the company's materials are used, is of the same order and must be regarded as entirely unethical.

D. W. MEAD, Past-President and Honorary Member, Am. Soc. C.E.

Madison, Wis.

Similar problems of professional relations will be treated by Dr. Mead each month. Next in sequence, for study and written discussion by members until May 5, with answers in the June issue, will be the following:

QUESTION NO. 9: *A young engineer through carelessness damages a transit which he was using on certain work for the state. The transit was repaired at state expense. The work on which this transit was used was delayed by the action, and the senior engineer in charge was obliged to make a trip to the state capital in order to secure the repair of the transit. Was the senior engineer justified in taking twenty-five dollars offered to him by the young engineer who had caused the damage?*

Soil-Sounding Devices and Subsurface Investigation Problems

TO THE EDITOR: In the December issue A. R. Lamm, in his article on "Soil Penetration Tests with a Loaded Auger," gives publicity to a method of determining subsurface conditions which, I believe, might be both costly and dangerous if used very widely. The loaded auger has the same disadvantages as the more conventional type of sounding rod, ordinarily used only for very preliminary investigations or to determine the depth of a firm stratum known to be present in the area under investigation.

No information as to the type of material through which the auger passes is obtained by this method, nor is the depth of ground water determined. Without this information both designers and builders should be reluctant to proceed. Mr. Lamm states that, "Borings in open pits produce a velocity of penetration greater than borings from original grades." This is logically to be expected, and for the same reasons the velocity of penentration will decrease with depth. Consider a deep bed of soft clay. At a sufficient depth, skin friction on the steel rods will eventually cause the penetration of the loaded auger to be less than 20 in. per 25 half turns. Will the soil at this depth then have a bearing capacity suitable for direct foundations? Or, if this penetration test is continued until the velocity of penetration is 2 to 3 in. per 25 half turns, can the piles be driven without knowledge of what may lie below the "firm ground" which caused the resistance to penetration by the auger?

It may be stated categorically that it is unwise and often extremely dangerous to design a foundation without knowledge of the soil conditions below the depth to which the foundation structure itself will be carried. Even light buildings are not exempt from this rule. H. A. Mohr's excellent pamphlet, "Exploration of Soil Conditions and Sampling Operations" (published by the Harvard Graduate School of Engineering), gives some interesting examples. Undesirable and structurally dangerous settlement may occur because of the existence of compressible strata many feet below foundation grade. Dr. Karl Terzaghi recommends that borings be made to a depth equal to one and a half times the width of the structure.

A not uncommon subsurface condition is that of a relatively firm and compact clay or sand overlying a soft compressible stratum. With complete information available, light structures can often be founded in the stiffer stratum, while heavy buildings will be constructed on piles or caissons carried through the soft material to hardpan or rock. Any structure founded in the upper stratum without regard for the presence of the underlying weak material runs the risk of suffering not only excessive settlement but even actual failure by overturning.

I do not wish to urge abandonment of the use of this and other soil-sounding methods altogether, although I myself would prefer to employ other means of investigation. In any area where general subsurface conditions are already well known through previous drilling or excavations, and it is desired only to establish locally the depths of particular strata, soil sounding may be both cheap and reliable. But the need for complete foundation investigations and the dangers of unreliable or incomplete borings and soundings cannot be emphasized too strongly, and I feel it imprudent to consider any soil-sounding device as a possible panacea for subsurface investigation problems.

Gatun, C.Z.

WILSON V. BINGER, Jun. Am. Soc. C.E.
Foundations Engineer, Atlantic Third Locks, The Panama Canal

Danger of Neglecting Fire Protection

TO THE EDITOR: An item in the February issue disturbs me considerably. Under the title, "Conservation of Critical Materials," Colonel Hill and Mr. Zackrison state that fire-protection facilities have been reduced and automatic sprinklers eliminated in the interest of the conservation of critical materials. It seems to me that these statements give a somewhat misleading impression. The reader is apt to get the idea that automatic sprinklers and other fire-protection features are not essential. He is also likely to get the impression that it is the policy of the War Department to eliminate fire protection, and this, in my opinion, is not the case as a matter of general policy, although certain offices in the War Department may have been proceeding on such a basis.

It is of the utmost importance to the war effort that production facilities, raw materials, and stocks of finished products should not be destroyed by fire. I fully appreciate the need under war conditions of establishing the policy enunciated in this article that nonessential construction must be eliminated and essential construction simplified to the bare minimum which will serve the purpose for the time being. It is my considered judgment, however, that if automatic sprinklers and other fire-protection facilities are eliminated, it is highly probable that disastrous fires will occur, destroying far more material than was saved by the elimination of the automatic sprinklers.

Many engineers who have not specialized in fire protection apparently fail to appreciate the relationship between automatic-sprinkler protection and other features of design. The need for fire protection depends upon the combustibility of the structure and its contents and the amount and importance of the materials subject to possible destruction by fire. The substitution of wood for non-combustible building materials, as discussed in the article in question, naturally results in an increased fire hazard which under proper engineering design should be compensated by increased fire protection. It is not reasonable to base decisions as to the need of fire protection in large wooden structures upon the peace-time practices for non-combustible structures.

Another exceedingly important factor is the size and value of the structure and its contents and its importance in relation to the war effort. There is a definite relationship between these factors and fire-protection design. Under present conditions automatic sprinklers may reasonably be omitted in all buildings which could be destroyed by fire without any adverse effect upon the war effort. They can likewise reasonably be omitted in case manufacturing or storage facilities are subdivided into small, segregated units, so designed that complete destruction of one or two units would not have any material effect upon the utility of the project as a whole. Present design practice in structures erected for war purposes, however, has been to erect buildings of areas far greater than under peacetime practice. Such large-area buildings, lacking subdividing fire walls and having no automatic sprinkler protection, are subject to complete destruction in case fire from any cause starts in any part of the building.

Boston, Mass.

ROBERT S. MOULTON
Technical Secretary, National Fire Protection Association

Future of City Planning and Housing

TO THE EDITOR: At the recent meeting of the Society there was a section devoted to city planning. I was surprised at the small attendance and the evident lack of interest on the part of engineers in city planning and housing. It is difficult to ascribe reasons for this. Opportunities are now available, and greater opportunities will come to the engineer in this field if he pays prompt and proper attention thereto.

Heretofore the engineer has been employed in a secondary position on multi-story structures, principally to help the architect in designing structural, sanitary, or mechanical features. The engineer has rarely taken a position of leadership in developing city plans or large housing jobs, or in the promotion of housing projects. In recent years development of the principle of zoning in cities has opened up new opportunities, to which the engineer should pay attention. He should also be aware of the laws governing zoning and housing. If the engineer pays attention to the New York State laws he may be able to suggest improvements in the State Housing Laws and in the Urban Redevelopment Laws. These laws have not helped much in promoting new projects because of certain impractical restrictions.

If the engineer will interest himself in housing and city planning, he can now find many finished projects from which to make studies and observations. Very interesting texts have also been developed by the city housing authorities, state housing boards, and the U.S. Housing Authority. These give summaries of laws, records of actual jobs, costs of construction work, sites, and experience in operation.

After the war our cities and rural districts will probably be to a large extent rebuilt. If the engineer is to take his proper place in the large projects that will be built, he should now familiarize himself with the problems. He should not only know his technics but should be familiar with the economics of land, building, and shelter. He should make a study of building codes, jurisdictional labor disputes, finance in construction, and selection of land for building projects. He should also endeavor to take the initiative in projecting jobs.

There are available for the engineers' use quantities of information amassed during the past decade. In addition to the handbooks released by the U.S. Housing Authority, there are also valuable monographs issued through the Division of Foreign Housing Studies of the WPA on housing in France, England, the Soviet Union, Denmark, Spain, Italy, Chile, Argentina, Germany, Holland, and other countries. Bibliographies on prefabricated houses, such as that issued by the *Architectural Forum*, are also available.

The engineer would fulfill his mission more completely if he took an interest in city planning and housing, which should be one of the most prolific sources for employment of his talents—especially after the war. The prime requisite is that he should not leave this work entirely to amateurs, promoters, speculators, and social uplifters.

Brooklyn, N.Y.

JACOB MARK, M. Am. Soc. C.E.
Consulting Engineer

Historic Railway in Brazilian Rubber Country

TO THE EDITOR: Because of the scarcity of rubber, attention is again being focused on the undeveloped resources of the upper valley of the Amazon River, and also on the Madeira-Marmoré Railroad. The latter, according to *La Prensa*, may yet render very valuable service to the cause of the United Nations. Rio Marmoré, lying within or on the border of Bolivia, flows into Rio Madeira, one of the largest tributaries of the Amazon system.

This short railway line is the sole by-pass for transferring freight around the dangerous rapids of the Rio Madeira, making feasible the passage of products of the Brazilian and Bolivian hinterlands by the shortest route to Atlantic seaports. Younger readers, very likely, will know little about this 200-mile railroad, located in one of the densest jungle areas in the world, but older readers of CIVIL ENGINEERING may recall *Recollections of an Ill-Fated Expedition to the Headwaters of the Madeira River in Brazil*, by Neville B. Craig (J. B. Lippincott Company, Philadelphia, 1907).

This narrative is one of the stirring chapters in the annals of American engineering. It should be listed as required reading for all students in civil engineering courses, not alone for its historical value, but also because it records an enterprise in which members of the Society held important assignments and fulfilled them under great hardships and with high courage. Two figures associated with the Madeira-Marmoré Railroad project are not easily forgotten. They are Lt. Lardner Gibbons, U.S.N., and Col. George Earl Church, M. Am. Soc. C.E.

It was Lardner who, in 1851, traversed South America, starting from the Bolivian frontier, journeying by canoe through the tributaries of the Amazon, thence down the great river to Para, Brazil, covering in the neighborhood of 3,000 miles with little aid and with meager technical equipment. That he was able to collect and assemble data on climate, topography, and river navigation is, even now, amazing. His data supplied the first mid-continent profile of South America, and much information that bore on the route selected for the outlet of products from interior regions of the upper Amazon twenty years later by Church.

George Earl Church was born in New Bedford, Mass., in 1835. His is a career that is yet to be matched. Equipped with a high school education only, he started his professional work at seventeen as topographical assistant on the Massachusetts surveys. At twenty-one, he was resident engineer on the Hoosac Tunnel; at twenty-two, engineer on Argentine railway location. This was followed by an interlude exploring in Patagonia and the Araucanian Indian country in southern Chile. At twenty-five, he was chief assistant engineer for the Great Northern Railway at Buenos Aires.

Then came the American Civil War. From captain, Church advanced to brigade commander in the Army of the Potomac at thirty years of age. Again Latin-America claimed him and at thirty-three he explored the upper Amazon valley, laying the background for his work later as director of the project known as the Madeira-Marmoré Railroad. In his time, no man knew more of the history, geography, and resources of South America. His vision may yet be realized, as we have pointed out. It was bound up in the completion of his railroad as a link in a route which would open up for immigration and commercial development the great areas of the upper Amazon.

EDWARD D. KINGMAN, Assoc. M. Am. Soc. C.E.
Boston, Mass.

SOCIETY AFFAIRS

Official and Semi-Official

Attractive Spring Meeting in Dallas Planned by Texas Section

Board and Society Members to Attend April 6, 7, 8; also Alabama Section Meeting on April 9, 10 in Birmingham

WITH THEIR usual enthusiasm, committees of the Texas Section have been planning to welcome many members from outside of Texas to the Section's semi-annual meeting in Dallas, April 6, 7, and 8. Texas members know well what this means. For the benefit of others it need only be mentioned that the attendance, the program, and the interest of these meetings are usually on a par with those of the Society's regular quarterly meetings.

As a matter of fact, the Dallas gathering will have many of the features of such a Society meeting without being so designated officially. At least it has the earmarks in that the sessions of the Board of Direction and its committees will precede it, and in that the Local Section Conference will form a part of it. Thus officers, committee members, and Local Section delegates will add their numbers and their interest.

Because of crowded hotel conditions due to the war, the normal schedule of preliminary and Board meetings has been condensed and arranged to begin a day later than usual. All activities will be held at the Baker Hotel. Committee meetings are announced for Monday, and the Board will limit its sessions to two, or possibly three, on Tuesday. Then on Tuesday evening the Texas Section will hold an informal dinner gathering for the particular benefit of Board members; but early attendants for the Section meetings to follow will also be most welcome. In addition, every visiting engineer is expected to attend a meeting following this dinner.

With these preliminaries completed, the stage will be set for the Local Section Conference. All of Wednesday has been reserved for this event. Delegates are expected from many of the Sections in the Southwest and Central areas of the country. A full program tied in to the present problems of engineers and their organizations is being scheduled.

Registration for the Texas semi-annual meeting will take place on Wednesday and on Thursday morning. Briefly, the program calls for technical sessions Thursday morning and afternoon. According to present plans, it will be possible for some of the visitors, especially those who expect to attend the Birmingham (Ala.) meeting the following day, to catch a late afternoon train on Thursday. A formal dinner will be held on Wednesday evening and a group luncheon Thursday noon. At the dinner there will be observed the annual ceremony of awarding Life Membership certificates.

Except for possible last-minute modifications, the technical program is expected to adhere generally to the following schedule:

Thursday Morning, April 8

Technical Program

"Employment Conditions for Engineers," by HOWARD F. PECKWORTH, *M. Am. Soc. C.E., Assistant to the Secretary, Am. Soc. C.E.*

General discussion and question period

Business Session, Texas Section

Conducted by JOHN H. BRINGHURST, *President, Texas Section, Chief Engineer, American Republics Corporation*, Houston, Tex.

Luncheon, Baker Hotel

Thursday Afternoon, April 8

Technical Program

"Post-War Planning," by W. R. WOOLRICH, *Dean of Engineering, University of Texas*, Austin, Tex.

General discussion

"Fundamental Principles of Embankment Compaction," by THOMAS E. STANTON, *Vice-President, Am. Soc. C.E., Materials and Research Engineer, State Division of Highways*, Sacramento, Calif.

Discussion by

FRANK H. NEWMAN, JR., *Assoc. M. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A., Galveston District*, Galveston, Tex.

HORACE S. KERR, *M. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A.*, Dallas, Tex.

RAYMOND DAWSON, *M. Am. Soc. C.E., Associate Professor of Civil Engineering, Testing Engineer and Assistant Director, Bureau of Engineering Research, University of Texas*, Austin, Tex.

So planned as to conveniently follow the Dallas meeting, a two-day program, starting Friday noon, April 9, has been arranged by the Alabama Section to be held at the Thomas Jefferson Hotel in

Courtesy of the Austin Co.

EMBLEMATIC OF THE WAR EFFORT OF TEXAS IS THIS AIRCRAFT ASSEMBLY PLANT

Dallas Skyline Shows Business District for City of 300,000

Birmingham. A number of Society officers and possibly others are planning to return east in time to take advantage of this opportunity to enjoy the hospitality of the Alabama group. Technical sessions Friday afternoon and Saturday morning will complete the engineering program, and a Section dinner is scheduled for Friday evening. The attractive technical program has been scheduled to include the following:

Friday Afternoon, April 9

"The Engineer in Business," by J. T. Ewin, *Vice-President, Doulutt & Ewin, Engineers and Contractors*, Mobile, Ala.

Discussion by

Herbert A. Davies, *Assoc. M. Am. Soc. C.E., Manager, Virginia Bridge Company*, Birmingham, Ala.

E. E. Michaels, *M. Am. Soc. C.E., Manager, Birmingham, Plant, Chicago Bridge and Iron Company*, Birmingham, Ala.

"Problems in Aircraft Design," by D. C. A. du Plantier, *M. Am. Soc. C.E., Vultee Aircraft Corp.*, Nashville, Tenn.

"Construction, Operation of Bomber Modification Plant," by L. M. Miller, *Facilities Manager, Bechtel, McCone and Parsons, Birmingham, Ala.*

Saturday Morning, April 10

Student Chapter Meeting

Program extending throughout the morning

Morning Technical Sessions—Contemporaneous with Student Chapter Meeting

"Employment Conditions in Industry," by W. O. Hare, *Secretary-Treasurer, Alabama State Federation of Labor*

"Employer-Employee Relationships," by Howard F. Peckworth, *M. Am. Soc. C.E., Assistant to the Secretary, American Society of Civil Engineers*

"Railroads Under War Efforts," by E. M. Hastings, *M. Am. Soc. C.E., Chief Engineer, R.F.&P.RR.*, Richmond, Va.

"Engineering Activities in the National Capital," by Hal H. Hale, *M. Am. Soc. C.E., Assistant to the Secretary, American Society of Civil Engineers*

At the dinner on Friday evening, addresses will be made by Ezra B. Whitman, President of the Society, and by Charles B. Breed, Director of the Society, who will speak on "Post-War Effects of Air Transportation on the Railroads."

Conclusion of the Birmingham meeting, about noontime on Saturday, will permit visitors to catch afternoon trains. This meeting, like the preceding one at Dallas, has been carefully planned to give the maximum of helpful information, tuned to the war activities of engineers. Furthermore, it has been condensed to cover the minimum of time. For both these reasons, the meetings should be attractive.

It goes without saying that all Society members who can arrange to participate in these events will be heartily welcome. This applies particularly to those who, though not members of the Sections concerned, can arrange to be present. A hearty welcome always awaits visitors to these active southern Sections; this has been proved time and again at Society meetings held in both Texas and Alabama. And the meetings that have been outlined here will be no exception to the general rule.

Honesty Is the Best Policy

By and large engineers get along well with other engineers. One of the reasons—faith in the other fellow and ability to see his point of view—is exemplified by the following incident. It is taken directly from correspondence with Henry E. Riggs, Past-President and Honorary Member.

The occasion was in comment on the recent (February 24) death of Jere C. Hutchins of Detroit, at the age of 91. Dr. Riggs characterized him as "one of the Society's ablest, most fearless, most gentle members." In evidence he tells this story.

"About 35 years ago there was a terrible interurban wreck in Detroit. An express car left the track at high speed in the city, cut off a 50-ft telephone pole, destroyed a frame fruit stand, and crashed through the wall of a dry goods store. Several passengers, some clerks, and some patrons of the store were killed. I was living in Toledo then, doing consulting work. I got a call from the Prosecuting Attorney in Detroit a few minutes after the accident, asking me to come at once to Detroit. I was on the ground with him within two hours, before wreckage had been sufficiently cleared to get the car moved.

"He was all for putting police in charge of everything. My advice was to go to Mr. Hutchins (president of the railway company), whom I had never met, and ask for all equipment records, and to request company clearing of the wreck under our close supervision. (The first theory was that it was faulty equipment.) City officials all protested that Hutchins would never consent to our request but would destroy all records and evidence.

"I prevailed and we went to his office. He turned over everything to us, worked with us, and the result was clear proof that that and other wrecks were caused by the type of rail required by city ordinances, which could not be held to gage."

It is easy to understand Dr. Riggs' concluding comment, "From then on Uncle Jere and I were warm friends."

The Engineer in Foreign Service

V. Heavy Construction in the Pacific Area

From a Letter to A. C. Polk, M. Am. Soc. C.E.

A.P.O. 502, % Postmaster
San Francisco, Calif.
February 12, 1943

In her last letter, my wife enclosed a program from the Twelfth Annual Meeting of the Alabama Section. I would have liked very much to attend that meeting and to associate with the people present; however that was impossible. I have made many contacts with members of the Society in all branches of our armed forces in this part of the world—some Army, some Navy, and some

Marine. I served as Army engineering officer on a joint Army-Navy project, on which the Naval Engineering Officer was an Associate Member from Columbus, Ohio, and a past-president of the Section.

To have a common interest, other than that of winning this war, with people one meets in these out-of-the-way places, goes a long way towards helping morale.

Our Task Force left the States a little over a year ago, and was the first to cross the Pacific after war was declared. Quite naturally, we have seen a good part of the world since then and have been engaged in a lot of hard work under adverse circumstances. Instead of getting rusty in my profession, I have been lucky enough to be actively engaged in civil engineering and heavy construction during almost my entire Army service. Promotions have been almost non-existent in our outfit as it was fully officered when we left the States, but that is a matter of minor importance. Our main mission as Aviation Engineer Troops is to deliver sound engineering and construction when and where it is needed, and if the War Department is correct, we have been doing our share of that.

Please give my regards to friends in Birmingham and in the Alabama Section. I will be back when this war is over and I hope that will not be too far in the future.

Sincerely,
KENNETH D. BYRD, *Jun. Am. Soc. C.E.*
1st Lt. 810th Engineer Battalion (Avn.)

English Hospitality

THE CORDIALITY of English engineers toward American visitors is proverbial. Another example of this is the following letter just received at Headquarters:

"On the termination of a commitment which has hitherto prevented such action, I am now very glad to offer hospitality to any member of the Society who may be serving in England and wanting a home for a short leave.

"Such members will realize the limitation entailed by food rationing, by the lack of domestic or other staff, and by the preoccupation of everyone with some form of war effort: but the welcome is not less hearty.

"We cannot offer them a round of social life and entertainment, but just a quiet time in the heart of rural England, a fine old house in a lovely district."

Yours faithfully,
(s) E. S. LINDLEY, M. Am. Soc. C.E.

February 1, 1943

The address of Mr. Lindley is Wortley House, Wotton under Edge, Gloucestershire, England. The corresponding railroad stations are Charfield on the L.M.S. and Badminton on the G.W.R.

Still another invitation has come from South Africa, from Thomas Breslin, Assoc. M. Am. Soc. C.E., who writes: "Should any members of the Society in the American forces be visiting Johannesburg, I would be very pleased indeed to have some share in their entertainment." His address is Care of Rand Water Board, P. O. Box 7794, Johannesburg, Union of South Africa.

Paper Restriction Handicaps CIVIL ENGINEERING

LIKE ALL other publications, CIVIL ENGINEERING is required to meet a 10% reduction in the tonnage of paper used during the current year over 1942. This imposes certain hardships which we must ask our readers to share with us.

The details tend to be complicated, but the over-all situation is relatively simple. The number of Society members, and consequently the circulation, is continually on the increase. Because of the stock of paper on hand, it was not feasible to decrease the page size immediately. Accordingly the reduction had to be made largely in the number of pages per issue, and this reduction in turn was complicated by the fact that the restriction was imposed after commitments had already been made for the normal issue of Society publications at the beginning of the year.

It will be noted, therefore, that the over-all number of pages in this month's and last month's issues of CIVIL ENGINEERING is somewhat less than formerly. Even so, this size has been kept as large as it is only by drastic reduction in some phases of our circulation. For example, it has been the practice to hold extra copies to supply to members delinquent in their dues, as soon as such dues are paid up. It will no longer be possible to do this. Of course, the remedy in this instance lies in the delinquent member's own hands.

The editors accept these difficulties as necessary. The end in view is far more important than any temporary inconvenience. It is hoped that members also will feel a measure of pride in co-operating fully to the same end. Barring further required cuts in paper tonnage, it is expected that future issues of CIVIL ENGINEERING, while reduced by the 10% average, will nevertheless be more uniform in size.

John Debo Galloway, Honorary Member, Dies

WITH the death of John Debo Galloway, San Francisco consultant and Honorary Member, the Society loses one of its most distinguished members. Mr. Galloway died on March 10, at the age of 73.

A native of California—he was born in San José—Mr. Galloway had spent much of his career in that state. Following his graduation from Rose Polytechnic Institute in 1889, he was engaged in railroad work in Washington. He then (1892 to 1896) was chief engineer for a contracting firm engaged in general construction, and from 1897 to 1899 taught at the California School of Mechanical Arts. In 1900 he established his own consulting practice, which he maintained for six years. From 1906 to 1908 he was a member of the architectural and engineering firm of Howard and Galloway, and from 1909 to 1917 of the engineering firm of Galloway and Markwart.

JOHN DEBO GALLOWAY

During the first World War Mr. Galloway served as Major of Engineers with the A.E.F. in France, functioning as a member of the General Staff at Chaumont. On his return to this country, the partnership with Mr. Markwart was revived and existed until the end of 1920. From then on Mr. Galloway maintained a consulting practice in San Francisco, his work including the design and construction of some of the city's principal buildings. He was a pioneer in the design of earthquake-proof structures, as well as in the field of hydroelectric plant construction. In his capacity as consultant to the Pacific Gas and Electric Company and the Bay Counties Power Company, Mr. Galloway designed and supervised the construction of several important hydroelectric power projects. It has been said, in fact, that during his long career he has been connected in some measure with most of the important structural problems of northern California.

One of his most outstanding services for the Society was his chairmanship of the Society's Earthquake Committee, which was instituted after the Japanese disaster of 1923. After years of study his committee produced a monumental report, which has been widely consulted for information on earthquake problems. He was a charter member and former president of the San Francisco Section, and similarly served many other technical groups. Long a member of the Society, he was elected Honorary Member in 1940. In the same year he received the Thomas Fitch Rowland Prize for his paper on "The Design of Rock-Fill Dams."

No civil engineer on the Pacific Coast has enjoyed a more secure place in the esteem and affection of his fellows.

"He Is Waiting to Be Asked"

NUMEROUS inquiries from engineers aspiring to Society membership have indicated the need of a little missionary work. Many qualified for membership hesitate to apply because they are not familiar with the proper procedure or because they are not acquainted with the particular advantage of the affiliation. Recognizing this need, the *Journal* of the Engineering Societies of New England recently had an editorial under the above title, from which the following has been extracted.

"No one questions the value of affiliation with a recognized technical society. Even in normal times it offers the best and latest information in a given field as well as the opportunity to meet in discussion those who have valuable experience. Today such increased demands are being made upon the engineering profession that no possible source of additional material should be overlooked. During the past two years, the number of persons performing technical work has been considerably augmented.... It is this group in particular that could benefit to the fullest extent from the educational program which every engineering society normally carries on as a matter of policy....

"We have personally interviewed several prospects ... and have found them very receptive and only waiting to be asked.

"Membership committees should be alert to the signs of the times and should not delay launching the campaign which will build up the societies' prestige and prove beneficial to those who enroll.

"Remember, you are doing the individual a service and he is waiting only to be asked."

The experience of one member of a national professional society is illustrative. Explaining that a technical society offers the individual the best and most recent technical information available, he secured the enrolment of fifty new members in two weeks.

Stretch Supply of CIVIL ENGINEERING

PAPER SHORTAGE has reduced the number of copies of CIVIL ENGINEERING printed, and the effect is becoming apparent. The last, or March, issue is already practically exhausted. In this emergency the Society has been forced to refuse new individual subscriptions to non-members, although it still is filling all subscriptions to libraries or organizations.

Perhaps members can be of direct assistance in this emergency, which is particularly acute as regards the March and April issues. Where more than one copy comes to a household or to an engineering office, the extra copy might be returned to Headquarters. Also, some members when they are through with their copy might be willing to return it for Society stock, using the envelope of the succeeding issue. The Society will be only too glad to refund the necessary postage of 4 cents.

By such cooperation it is hoped that the more important demands for the March and April numbers can be met. If the shortage continues longer, members will be informed.

The Future of the Engineering Profession

By R. L. SACKETT, M. AM. SOC. C.E.

DEAN EMERITUS OF ENGINEERING, PENNSYLVANIA STATE COLLEGE, STATE COLLEGE, PA.

DURING the last few years there has been a very definite increase in the proportion of high school boys who want to know about engineering. Engineering enrolments and graduations have increased partly owing to war-accelerated programs and partly to the general esteem in which an "Engineer" is held. As a result, the number of Student Chapter or branch members has increased as these young men look toward engineering as a career.

Furthermore, thousands are taking ESMWT courses, refresher, vestibule, or back-stairs courses, which will later be presented, with experience, as evidence of ability to enter an engineering society, to obtain a license, or both. Some will have made good and will deserve recognition; some will not be equipped for the venture, and will be deflected into other lines; some will join a union of technicians. Numerous difficult and important questions face the engineering societies and the state registration boards.

GUIDANCE

While there is no means of warning the large numbers who at the present time are consciously or unconsciously knocking at the door of the profession, it seems clear that greater efforts should be made to advise high school boys—and girls—who are interested in engineering as to the ability required, hard work involved, and personal qualities needed for advancement. There are rather definite demands which real engineering will make on those entering the profession through the streamlined college curriculum or by some other route. If the engineering societies and the registration boards uphold their standards of professional ability and their attitude in defense of the public safety, then the counseling of high school boys is of importance to the profession.

NOTABLES AT CANADIAN DINNER

A particularly happy moment is recorded in this view taken at the annual banquet of the Engineering Institute of Canada, at Toronto. The date was February 11, and the occasion was the Fifty-Seventh Annual Meeting of the Institute. The central figure is Ezra B. Whitman, President of the Society, in the act of responding to the retiring President of the Institute, C. R. Young, M. Am. Soc. C.E., at the left. Beyond President Whitman is H. V. Coes, President of the A.S.M.E., while above appears the emblem of the Institute.

The standards for admission to engineering colleges are much the same as those for admission to other curricula except that greater weight is given to preparation in mathematics, science, and drawing. It is therefore desirable that those who have the necessary mental and personal equipment needed for engineering should begin their preparation in the junior year of high school or earlier. Those who do not have these desirable qualities might well devote their energies to preparing for fields for which they are better fitted by scholarship and temperament.

TESTING ENGINEERING APTITUDE

College admission practice does not usually attempt to determine whether or not a student has the engineering type of mind. There are several reasons—one is tradition; another is the law in some states requiring a Land Grant college to admit anyone having a high school diploma; and another is the lack of generally accepted and proved bases of differentiating those engineering students who promise better than average performance.

The Engineers' Council for Professional Development has organized committees of engineers in various cities to cooperate with high school officials in a guidance program which has been successful in emphasizing the attributes a boy should have who is considering admission to an engineering college.

At the same time, the E.C.P.D. is studying tests designed to suggest the degree of engineering ability which a prospective student has. President A. R. Cullimore of Newark College of Engineering is chairman of the E.C.P.D. Committee on Student Selection and Guidance, which is attempting to serve the engineering profession by urging boys to consider carefully the realities—the demands which an engineering education and successful practice will make on them.

Society's Yearbook for 1943

WITH the April PROCEEDINGS, which will reach members shortly after the middle of the month, the annual Yearbook number will be included as Part 2. While this volume will contain substantially the same information as past issues, there are a few changes that might be noted.

The main adjustment has to do with the overall size, which has been reduced because of the obligation placed upon the Society to restrict its use of paper. Thus the 1943 Yearbook will be approximately 10% smaller than usual. But it will be larger than usual as regards the membership list, both alphabetical and geographical. This is of course inevitable owing to the increase in the total number of engineers affiliated with the Society, totaling 18,539 members. It means, however, that the rest of the volume had to be reduced by even more than 10%.

As for the deletions, it appeared that certain details might well be condensed or omitted in this particular year—for example, the full list of prize winners, of life members and of past and present officers, also parts of the Annual Report. As for the latter, it may be obtained in full on request to Headquarters. While the lack of this material in the present Yearbook will not be serious, nevertheless members should retain their copy of that for 1942 so as to have the omitted information at hand if needed. It is hoped that present restrictions will shortly be lifted so that the Yearbook can have its full content in future.

During the emergency another expedient has been resorted to in order to save paper. The number of copies printed has been cut down substantially so as to provide only for immediate needs. Stocks are expected to be exhausted shortly, and hence members are urged to be especially careful of their 1943 Yearbook—as well as of the 1942 copy.

CIVIL ENGINEERING in the Navy

FOR SOME MONTHS the Society has been donating copies of CIVIL ENGINEERING to a number of military and naval establishments. That this service is appreciated is quite evident from a recent acknowledgment to the Society, as follows:

"On behalf of the enlisted men here at the Section Base, please accept their grateful thanks for sending your monthly publication CIVIL ENGINEERING.

"Those close to the subject consider it the very finest of its kind and of definite interest and great help to them. They look forward to each month's new issue with genuine enthusiasm.

"*Very truly yours,*
(S) LEONARD MONSON PENN
Ship's Library, Yeoman-in-Charge
U.S. Naval Section Base
San Pedro, California"

Junior and Student Chapter Emblems No Longer Available

AS A RESULT of government priorities, the scarcity of metals, and the manpower situation, the jeweler who manufacturers the Society's membership emblems advises that he will be unable to supply further orders for Junior and Student Chapter charms and pins for the duration.

Thus the Society will be unable to fill orders for such emblems reaching Society Headquarters after March 1. Orders that were received prior to or on that date will be filled.

Appointments of Society Representatives

T. L. CONDRON, M. Am. Soc. C.E., represented the Society upon the occasion of the presentation of the Washington Award to Dean A. A. Potter, which took place at the Union League Club in Chicago on February 24.

WILLIAM G. RAPP, Assoc. M. Am. Soc. C.E., has been appointed the Society's representative on the Sectional Committee of the American Standards Association on a Safety Code for Cranes, Derricks, and Hoists. He will fill the vacancy caused by the death of CARLETON GREENE, M. Am. Soc. C.E.

News of Local Sections

Scheduled Meetings

ALABAMA SECTION—Two-day meeting at the Thomas Jefferson Hotel on April 9 and 10.

CENTRAL OHIO SECTION—Luncheon meeting at the Fort Hayes Hotel on April 15, at 12 m.

CLEVELAND SECTION—Dinner meeting at the Cleveland Eng. Soc. Hotel (2136 E. 19th St.), on April 9, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the University Club on April 12, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on April 19, at 12:15 p.m.

DISTRICT OF COLUMBIA SECTION—Dinner meeting at the Cosmos Club on April 20, at 6:30 p.m.

GEORGIA SECTION—Luncheon meeting at Davison's Tea Room on April 2, at 12:30 p.m.

ITHACA SECTION—Dinner meeting at the Arlington Hotel, Binghamton, on April 30, at 7 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on April 14, at 6:15 p.m.

METROPOLITAN SECTION—Meeting in the Eng. Soc. Bldg., on April 21, at 8 p.m.; meetings of the Junior Branch on April 7 and 21, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on April 1, at 7 p.m.

NORTHEASTERN SECTION—Dinner meeting at the Engineers' Club on April 21, at 6 p.m. (Joint meeting with the Boston Society of Civil Engineers.)

NORTHWESTERN SECTION—Dinner meeting at the Campus Club on April 5, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on April 13, at 6 p.m.

ROCHESTER SECTION—Dinner meeting and Ladies' Night at the Y.M.C.A., on April 29, at 6:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on April 26, at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club of San Francisco on April 20, at 5:30 p.m.

SPOKANE SECTION—Luncheon meeting at the Davenport Hotel on April 9, at 12 m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S. & W. on April 13, at 5:45 p.m.

TEXAS SECTION—Spring meeting at the Baker Hotel on April 6, 7, and 8; luncheon meeting of the Dallas Branch on April 5, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on April 12, at 12:15 p.m.

WEST VIRGINIA SECTION—Dinner meeting at the Winsor Hotel, Wheeling, on April 2, at 6:30 p.m.

Recent Activities

BUFFALO SECTION

At a luncheon meeting held on February 25, members of the Buffalo Section heard a talk on "Imperial and Soviet Russia." The speaker was Dr. Alexander Schwarcman, director of research for the Spencer Kellogg Company. Dr. Schwarcman, a native of Poland who has lived for many years in Russia, covered historical highlights, which have an important bearing on the Russia of today. He was followed by John W. Cowper, Director of the

Society, who discussed the Dollinger Bill, recently introduced in the New York State Legislature. This bill requires that private engineers in public utility work in cities of over a million shall be in Civil Service. It was moved, seconded, and passed that the president and secretary of the Section be authorized to make a protest in the name of the Section.

Central Illinois Section

A joint meeting of the Section and the Springfield Engineers' Club took place in Springfield on February 18. There was a record attendance, over 200 being turned away for lack of room. The guest of honor and speaker was Harold W. Richardson, western editor of *Engineering News-Record* and *Construction Methods*, who spoke on the Alcan Highway. Mr. Richardson has been over the entire project, having been sent as a war correspondent by the government, and was present at the dedication ceremonies. Numerous colored slides—made from photographs taken on the scene by Lt. Col. R. F. Schilsky—were then shown.

Central Ohio Section

On February 18, M. L. Pool, associate professor of physics at Ohio State University, addressed the Section's luncheon meeting, giving an illustrated lecture on the cyclotron in operation at the university. Dr. Pool outlined the atomic structural changes in elements that the cyclotron can cause and discussed its possibilities for the future in the fields of engineering and medicine. The annual election of officers, held at this time, resulted in the selection of Alvan Tallmadge for president, and Guy H. Elbin for first vice-president.

Cincinnati Section

The seventh annual joint meeting of the Technical and Scientific Societies Council of Cincinnati, of which the Section is a member, was held on February 23. There was a turnout of 900 to hear D. C. Prince, vice-president of the General Electric Company, speak on the "Plan for Post-War Planning." Mr. Prince, who is also chairman of the Industrial Advisory Board of the Committee for Economic Development, illustrated his subject by numerous tabulations showing estimated demands upon industry after the war.

Cleveland Section

"Post-War Planning for Cleveland" was the subject of discussion at the February meeting of the Section, the speaker being John T. Howard, planning director for the city of Cleveland. Mr. Howard pointed out that the automobile industry helped restore employment in private industry after the last war. What will perform a similar role at the end of the present war, no one knows. However, the Cleveland Planning Commission is working on plans for post-war public works to the amount of $100,000,000. The Ohio State Highway Department, the Cleveland Board of Education, the Cleveland Metropolitan Housing Authority, and a lakefront development have all planned similar post-war developments.

Dayton Section

Members of the Section in the armed forces stationed at Wright and Patterson Fields, who are unable to attend luncheon meetings, were invited to a dinner and technical session on February 9. The program consisted of the showing of slides and motion pictures depicting the construction of soil-cement pavements, now much used in airport construction. The film was presented by H. A. Humphrey, engineer for the Portland Cement Association.

District of Columbia Section

The Section's annual dinner took place on January 28. In the absence of the scheduled speaker, who could not attend on account of illness, the subject—"We Are in it Together in the Defense of Civilization"—was ably handled by L. B. Pearson, counsellor of the Canadian Legation, and Dean Elmer L. Kayser, of George Washington University. Both speakers stressed the great value of the close cooperation existing between the United States and Canada. Mr. Pearson was introduced by the Canadian minister, the Hon. Leighton McCarthy, who called attention to the engineering ties between the two countries. Society officers present included President Whitman and Directors Carey and Requardt. At the regular monthly dinner meeting, held on February 16, Rear Admiral L. O. Colbert addressed the Section on the subject, "Surveying and Mapping in Global War." Admiral Colbert is director of the U.S. Coast and Geodetic Survey.

Georgia Section

Recent meetings of the Section include a joint session with the Georgia Engineering Society, held on February 8, and the regular February luncheon meeting. The speaker at the former gathering was J. B. Akers, assistant chief engineer of the Southern Railway, who discussed the achievements of the railroads in the war emergency. At the luncheon meeting Lt. Comdr. L. F. Bellinger spoke on the Alcan Highway. He was followed by C. A. Smith, whose subject was "Urban Transportation in Wartime."

Iowa Section

At the February meeting of the Section, T. R. Agg, Vice-President of the Society, discussed the recent activities of the Board of Direction, and F. M. Dawson and L. O. Stewart reported on the Annual Meeting. The technical speaker was C. M. Stanley, Jr., consulting engineer of Muscatine (Iowa), whose subject was "War and the Engineer." The feature of the occasion was the presentation of the Section's prizes of Junior membership in the Society to Fred Nance, of Iowa State College, and Loren A. Duffey, of the State University of Iowa.

Ithaca Section

The Section's February meeting took the form of a joint dinner with the Cornell Student Chapter. The guest speaker was Harry T. Immerman, chief engineer for Spencer, White and Prentis, of New York. Mr. Immerman gave an illustrated lecture on "Underpinning," describing such interesting underpinning jobs as the Brooklyn Armory and the Yankee Stadium.

Los Angeles Section

"Russia in the War and World Affairs" was the subject of discussion at the February meeting of the Section, the speaker being Maj. Ivan Lebedeff. Major Lebedeff served in the Russian Army during the first World War and, at present, is a writer and lecturer on Russian affairs.

Metropolitan Section

A lecture on the Continental Divide Tunnel, illustrated by a technicolor moving picture, comprised the technical program at the February meeting of the Section. This was given by M. W. Terrill, district representative of the rock drill department of Ingersoll-Rand. Thirteen miles in length, the tunnel is believed to be the longest ever driven from two headings. Up until the time that work was halted because of the war, progress was being made at the rate of 1,500 ft per month at each end. Approximately 14,000 ft remain to be driven, along with concreting of the entire passage. When finished, the project will provide vitally needed water for irrigation on the eastern slope of the Divide.

At a meeting of the Junior Branch, held on March 10, Gordon M. Fair described a 15,000-mile trip he had made in 1942 through South and Central America as consultant to the Office of Inter-American Affairs. Professor Fair is on the staff of the Graduate School of Engineering at Harvard University.

Pittsburgh Section

An address by Maj. Gen. Eugene Reybold, chief of Army Engineers, attracted a large turn-out for the February meeting of the Section, which was a joint session with the Civil Section of the Engineers Society of Western Pennsylvania and the Pittsburgh section of the American Military Engineers. "Flood-control dams in operation in the watersheds of the Allegheny and Monongahela rivers prevented losses of $29,000,000 during the 36-ft flood at Pittsburgh," General Reybold declared.

North Carolina Section

The Section's annual meeting took place at North Carolina State College on January 30. During the annual business meeting the following new officers were elected: Carl W. Mengel, president; Nathaniel P. Hayes, vice-president (for two years); and George H. Maurice, secretary-treasurer (for two years). The technical program consisted of talks by Lt. Col. L. J. Lampke, assistant

professor of military science and tactics at North Carolina State College, whose subject was tolerance as applied to patriotism and the war effort; and Edward J. Cleary, managing editor of *Engineering News-Record*, who gave an illustrated address on current engineering construction projects. A review of Student Chapter activities—by James F. Kelly, president of the North Carolina State College Chapter, and Richard J. Lynch, president of the Duke University Chapter—concluded the program.

Philadelphia Section

An unusually interesting program had been arranged for the February social meeting. Following a delicious dinner, Lt. John M. Creighton, of the U.S. Coast Guard Reserve, discussed the dog-training work the Coast Guard is doing. Two members of the Coast Guard and their charges gave a very convincing demonstration. Other speakers were Maj. Thomas V. Frible, of the U.S. Army Signal Corps Depot, and Comdr. Thomas B. Wolverton, damage control officer of the cruiser *Boise*. Commander Wolverton gave a very vivid description of the battle in which the *Boise* sank six Japanese warships in the brief period of twenty-seven minutes. The meeting was then turned over to Lyle Jenne, master of ceremonies, who had arranged the usual diverting social program.

Rochester Section

On February 23 members of the Rochester Section heard E. L. Van Sickel, project manager for the John W. Cowper Company on the Kodak Optical Works at Rochester, discuss problems of wartime construction. A paper by Daniel B. Niederlander on the construction of Pine Camp concluded the evening. Owing to Mr. Niederlander's absence, because of illness, his paper was read by Mr. Van Sickel.

St. Louis Section

The principal speaker at the Section's February luncheon was L. D. Steiner, associate price specialist of the Eastern Missouri State Office of Price Administration. Mr. Steiner gave a brief description of the organization and work of the OPA and explained the essential requirements of the regulations affecting construction contracts. During the meeting it was announced that John Calhoun New, of the University of Missouri, is the recipient of the Section's prize of Junior membership in the Society.

Sacramento Section

At the first two meetings in February, two members of the Section proved to be able historians, Drury Butler tracing the "History of Steel and Its Uses," from early times, and W. P. Hargrave reciting the "Early History of the Southern Pacific Company," of which he is assistant division engineer. Pending legislation aiming at post-war expansion of the capitol buildings and grounds was discussed on February 16. At the concluding meeting of the month, James E. Mackie, of the San Francisco Section, gave a summary of recent applications of glued lamina in heavy timber framing.

San Francisco Section

The February meeting of the Section was addressed by Wright L. Felt, assistant regional director of the Federal Works Agency. Mr. Felt discussed post-war planning, pointing out that planning should be done before the end of the war. He believes in the development of natural resources as a means of taking up the slack in employment during the readjustment period following the war, and proposed that projects to accomplish that development be initiated by local communities and organizations.

On January 28 the Junior Forum discussed the question of whether the Army and Navy should take over the engineering colleges for training of personnel. The technical program consisted of talks on "Experiences in Field Engineering for a Contractor" by Harold E. Weber, and "Construction of a Cast-Steel Foundry" by John E. Cahill. Both speakers are members of the Forum.

Seattle Section

The highlight of the January meeting was a talk by E. B. Black, President of the Society, who discussed the accomplishments of the Society with reference to the war effort. Following the presentation of a certificate of life membership to Harold J. M. Baker, colored motion pictures of the second unit of Ross Dam of the Skagit Power Development were enjoyed. These were shown by E. R. Hoffman, superintendent of the Seattle City Light Company.

Spokane Section

A symposium on the use of substitute materials in wartime construction projects had been arranged for the February 12 meeting of the Spokane Section. Those taking part were Maj. A. C. Nauman, area engineer for the Corps of Engineers at the Spokane Air Depot, who discussed the significant changes in engineering design brought about by the war; W. L. Malony, consulting engineer of Seattle, whose subject was the effect on certain structures of the increase in design stresses allowed on certain critical materials; and H. Jack Reeves, utility engineer for the U.S. Engineer Office at Spokane, who emphasized the electrical and mechanical aspects of the use of substitute materials.

Tennessee Valley Section

The Section reports that the Chattanooga, Knoxville, and Asheville Sub-Sections held meetings in February. The speaker at the first of these sessions was Lt. Col. George M. Enos, of the Cincinnati Ordnance District, whose subject was "Ordnance Inspection and Expediting in Wartime." E. W. Lane, principal hydraulic engineer for the TVA, was present at the Knoxville meeting and gave an illustrated lecture on the subject, "Hydraulic Engineering in China, Past and Future." Motion pictures depicting the manufacture and use of steel in peace and war constituted the program at the Asheville meeting. The films were shown and explained by Joseph Dave, of the Dave Steel Company.

Tri-City Section

"The Private and Public Works Policy of the Post-War Period" was the subject of discussion at the January meeting of the Section. Those participating in the symposium were Mark Morris, traffic engineer for the Iowa State Highway Commission; C. A. Kuttler, of the National Life Insurance Company, of Montpelier; C. M. Stanley, Jr., of the Stanley Engineering Company; and H. M. Metcalf, of the Gould Construction Company. M. C. Lorenz, associate engineer for the U.S. Engineer Department at Rock Island, Ill., was chairman of the discussion group.

Virginia Section

The principal speaker at the annual dinner meeting of the Section—held in Richmond on February 12—was Comdr. J. S. Leister, of the U.S. Navy, who gave an illustrated talk on the Seabees. Another feature of the occasion was the presentation of certificates of life membership to J. E. Crawford, G. P. Jones, and F. P. Turner, of Roanoke; and R. D. Trimble, of Richmond. The new officers for the Section, elected at this meeting, are William R. Glidden, president; T. W. Roby, Richard Messer, and R. A. Marr, Jr., vice-presidents; and P. A. Rice, secretary-treasurer. The Society was represented at the gathering by Vice-President E. M. Hastings, Director Gustav Requardt, and Washington representative, Hal H. Hale.

Student Chapter Notes

Stanford University

The Stanford University Chapter has instituted luncheon meetings. The first—held on January 15—was a great success. The speaker on this occasion was L. Harold Anderson, city engineer of Palo Alto, who outlined the work and duties, as well as the trials and tribulations, of a city engineer.

University of California

The University of California Student Chapter closed its fall term with a meeting on January 21. There was a good turnout to hear the illustrated talk on "Foundations and Soil Mechanics," given by William W. Moore. Mr. Moore is a member of the San Francisco firm, Dames and Moore. Other recent Chapter activities include a field trip to a plant of the California Corrugated Culvert Company.

ITEMS OF INTEREST

About Engineers and Engineering

President Favors Post-War Public Works Planning

In one of his Sunday broadcasts, Mayor LaGuardia mentioned the efforts of the City of New York in stimulating advance preparation for the post-war period, including a public works program, and quoted a letter on the subject, addressed to him by President Roosevelt.

By the courtesy of Mayor LaGuardia that letter has been made available for reproduction here. The President's letter to the Mayor, dated March 1, 1943, reads as follows:

The White House
Washington

March 1, 1943

Hon. Fiorello H. LaGuardia
Mayor of New York
New York, N.Y.

My dear Mayor LaGuardia:

I was pleased to receive your letter of February 9 in which you enclosed a copy of the brochure on a "Proposed Post-War Works Program for the City of New York." It is indeed heartening to know that the City of New York is now actually preparing plans and specifications for a "shelf" of projects that may be undertaken without delay when the war ends.

I hope that other cities and States will follow New York's example, and to encourage them I have recommended to the Congress, on several occasions beginning as early as the spring of 1941, that Federal aid ought to be provided for such detailed plan preparation. But legislation to authorize appropriations for such Federal aid is still pending in the Congress. Perhaps, however, upon the basis of the pioneering done by New York in this field, the Congress will be more inclined to consider favorably the recommendations I have made.

With kind personal regards,

Sincerely yours,

(Signed) Franklin D. Roosevelt

Time Standards for Hydrologic Data

At 2:00 a.m. on February 9, 1942, the nation shifted from Standard to War Time. Several federal agencies called the attention of the Water Resources Committee of the National Resources Planning Board to the necessity of taking special precautions to avoid confusion in the recording and publishing of basic hydrologic data. At the request of these agencies, and in the interests of clarity in the collection and presentation of hydrologic data, the Water Resources Committee collaborated with the federal agencies involved in promoting (*a*) uniformity of marking records and (*b*) adoption of standard systems of recording. The accompanying table was prepared to record the results for the mutual advantage and use of all agencies. A full report is available at the offices of the Water Resources Committee, Washington, D.C.

Summary of Time Standards Used by Federal Agencies for Observing and Publishing Hydrologic Data During the War

Agency	Observation and Recording	Publications Intended as Permanent and Official Records
Forest Serv.	War	Standard
Soil Cons. Serv.	War	Standard
Bur. of Recl.	War	Standard
Nat. Park Serv.	War	Standard
Off. of Ind. Aff.	War	Standard
U.S.C. & G.S.	War	Standard
Internat. Boun. Comm. (U.S. and Mex.)	War	War
TVA	War and Standard	War
U.S.G.S.	War	War
War Dept.	War	War
Weather Bur.	War and Standard	Standard, in general

The Engineer Is Worthy of His Hire

Problems of engineering salaries are not confined to these modern days. An example is given in a paper on "The Status and Duty of the Engineer," written in the *Journal of the Association of Engineering Societies*, February 1914, by John A. Ockerson, Past-President, Am. Soc. C.E. He comments as follows:

"The anecdote of Prof. Hassler, the first Superintendent of the U.S. Coast Survey, illustrates conditions when engineering began in this country. It is related that Hassler went to the President [of the United States] and stated that his compensation was not commensurate with his services, and he wanted a higher salary. Said the President, 'You get as much as the Secretary of the Treasury, now.' 'That is all very well,' said Hassler. 'You can get plenty of men for Secretary of the Treasury, but there is only one Hassler—only one.' The story is silent as to the result of this interview, but it seems probable that the request of Prof. Hassler was granted."

N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

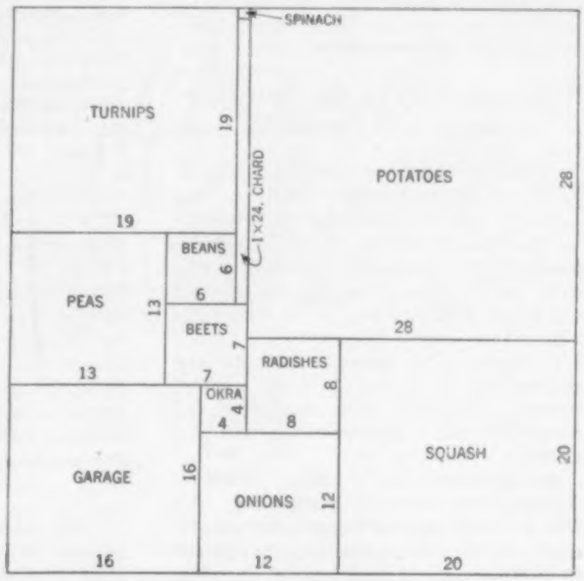
The Secretary had just announced that 25% of the members of our Engineers Club were in service and the President observed that not one Junior was present. The fact was obvious; we were all bald or gray, the left-overs, too old to fight this war.

"But not too old for Victory Gardens," observed Professor Neare. "If you don't thrill at the sight of sprouting spinach or budding beans, at least the weeds will give you a battle. Our Guest Professor Jenney sends his regrets tonite because ragweed and timothy have invaded his potato patch in force.

"This potato patch was our problem, you remember. His square backyard, except for the square garage in the southwest corner and a 1 by 24-ft row of chard, is laid out in square plots and no two are alike. The potato patch being the largest, where and how big is it?"

"If only the row of chard had been 25 ft long, I could do it," mourned Joe Kerr.

"That bothered me too," said Cal Klater. "My yard is the same size, so I went right ahead and planted it, including a 25-ft row of new chard. Not until I noticed the spinach seed left over did I have an inspiration. I spaded over one end of the row of chard and planted a square foot of spinach. That little spinach



Guest Professor Jenney's Victory Garden

just suits the law of supply and demand for us Klaters. Here's a map of the whole garden."

"Seems to fit the specifications, Cal. The 16-ft square had to be the garage, because nine such squares would fill the lot and Professor Jenney said he had planned once to lay the whole garden out in squares like the garage."

"That's right, Professor Neare. Of course there is another possible layout, the same as this one reflected about the SW-NE diagonal. In either case, the potato patch is 28 by 28 ft in the northeast corner."

"In fact, Cal, there are 16 layouts, all giving the same answer for the potato patch. The 20 by 32-ft rectangle in the northwest corner can be reflected about either its E-W or N-S axis. Also the 1 by 25-ft rectangle can be reflected about its E-W axis. The four reflections being independent, there are $2^4 = 16$ arrangements. I notice you adore turnips as much as you abhor spinach!"

"No, I applied a safety factor to the turnips. Last year I planted a 12-ft row of them and got just one turnip. If I should have a bumper crop this year, I'll put a cow in the garage!"

"Then you'd better not weed the timothy out of the potato patch.

"For our next problem, I offer a test in long division. Six tentative communists, Al, Ben, Cal, Don, Ed, and Fred, proposed to divide their money equally, but one, realizing that his $4,024 was more than the average holding, proposed an alternative that was adopted. So Al, retaining half his money, divided the other half equally among his friends. Ben did the same with the money he then had and the others followed suit. Imagine their surprise when a final tally showed that each man had the same amount. How much was it?"

[*This month Cal Klater is O'Kay (Otto H. S. Koch). Belatedly we add his name to the March list; his correct solution of Count de Myles' tire problem chased the Professor on a field trip, catching him at home after the deadline.*]

Commissions in the Sanitary Corps Still Available

A RECENT communication from Maj. J. J. Gilbert, of the Sanitary Corps, A.U.S., calls attention to the fact that commissions in the Sanitary Corps are still available. Rank of first lieutenant is open to applicants under 37 years of age, and that of captain to a limited number of exceptionally qualified applicants over 37. Duties will consist of consultation on sanitary engineering problems of water supply, sewage treatment, and mosquito and rodent control, wherever troops are stationed.

Qualifications are a degree in civil, sanitary, or chemical engineering, and four years of suitable engineering experience. Applicants should send full details to the Surgeon General, care of the War Department, Washington, D.C.

Water Treatment Records Placed in Engineering Societies Library

A "SUMMARY of Census Data on Water Treatment Plants in the United States, has been made available by the U.S. Public Health Service. A mimeographed copy of this report (Public Health Reports, Vol. 57, No. 45, November 6, 1942, pp. 1679 to 1694) has been placed in the Engineering Societies Library along with a complete set of the records from which the summary was derived.

This publication records basic data on individual water treatment plants, their sources of supply, date treatment started, rated capacity, population served, output, detailed treatment facilities or practices, plant laboratory control, and water storage capacity.

The data thus compiled were furnished by the sanitary engineering divisions of the various states at the request of the U.S. Public Health Service. All plants serving communities having a resident population of 100 or more have been listed in the tabulation.

Brief Notes

THE CITY Plan Commission of St. Louis (Mo.) has prepared a booklet entitled "St. Louis After World War II," in which a post-war rehabilitation program is effectively set forth. Specific actions called for include the permanent elimination of smoke nuisance; improved zoning regulations; strict enforcement of sanitary laws; removal of obsolete and repair of decadent structures; and establishment of adequate play and recreational facilities. The scope of this plan parallels the report prepared by the St. Louis City Plan Commission during the first World War, which resulted in the issue of $87,000,000 in civic improvement bonds.

* * * *

THE WAR Production Board has issued a list of specifications for steel products to be used on government orders. With certain exceptions, the order applies to all products produced or fabricated after February 25, 1943. A copy of the order may be obtained from the War Production Board.

* * * *

THE AMERICAN Institute of Consulting Engineers announces the election of new officers for 1943. Rear Admiral R. E. Bakenhus, new president of the organization, is one of the recently elected Directors of the Society. The other officers are Alonzo J. Hammond, vice-president; Philip W. Henry, secretary; and James Forgie, treasurer. All are members of the Society, and Dr. Hammond is Past-President.

* * * *

Two major generals who are close friends—Maj. Gen. Eugene Reybold, chief of Army Engineers, and Maj. Gen. C. J. Magee, Surgeon-General of the Army—have just returned from Africa, and their favorite story is how the engineer looked after the health of the doctor. In the course of their travels the Surgeon-General became separated from his professional equipment, but the far-sighted engineer hung on to his medical kit. General Reybold, who is a member of the Society, says "There was Magee without even a thermometer or a pill, and there was I with my medicine kit. So every time the Surgeon-General felt bad he had to come to the engineer. Just another job for the engineers looking after the health of the Surgeon-General. But as an engineer I'm happy to report that I brought back our dear Surgeon-General in tiptop physical condition." This story is told by the *Washington Times Herald* of February 5.

NEWS OF ENGINEERS

Personal Items About Society Members

MARVIN TAYLOR, formerly maintenance engineer for the Alabama State Highway Department, has accepted a commission as captain in the Corps of Engineers, U.S. Army. He is stationed at Camp Claiborne, La.

MAURICE L. ALBERTSON has severed his connection as research assistant in the hydraulic laboratory at Iowa State College in order to accept a position as junior engineer with the Tennessee Valley Authority, with headquarters in Knoxville, Tenn.

SAMUEL C. MCKEE, formerly assistant division engineer for the Ohio State Highway Department, has been appointed sanitary engineer for Lucas County, Ohio, with headquarters in Toledo.

FRANK B. WOOD, sanitary engineer with the U.S. Engineer Department, was recently transferred from the district office at Vicksburg to the office of the Mississippi River Commission and the Lower Mississippi Valley Division at Vicksburg.

JOHN E. RINNE, who is an engineer for the Standard Oil Company of California, is now located at Edmonton, Alberta. He was previously in the San Francisco office of the organization.

WILLIAM R. SEEGER has resigned as assistant engineer for C. C. Kennedy, of San Francisco, in order to become associated with Montgomery Ward in the capacity of industrial engineer.

F. E. BONNER, former San Francisco consultant, has been commissioned a lieutenant colonel in the Corps of Engineers, and is reported to have left the country in line of duty.

RICHARD I. LAND, for the past two years chief purchasing agent in charge of procurement for the Vermilya-Brown Company, Inc., has been loaned to Bermuda Base Contractors for its duration and is now engaged on an Army construction project at St. George's,

Bermuda. The Vermilya-Brown Company is one of the joint groups comprising Bermuda Base Contractors.

Ivan C. Crawford, dean of the college of engineering at the University of Michigan, is spending part of his time in Washington, D.C., as consultant to the Bureau of Naval Personnel in connection with the college training program.

Granville Parker has been granted a leave of absence from his position as chief engineer for the Colombian Petroleum Company at Cucuta, Colombia, in order to enter the Army of the United States, with assignment to the Corps of Engineers. He has the rank of captain.

Carleton M. Fyler is now a lieutenant in the Civil Engineering Corps of the U.S. Naval Reserve. Before reporting for active duty Mr. Fyler maintained a consulting practice in Toledo, Ohio.

Jack D. London has severed his connection with the Tennessee Valley Authority in order to enter the Army Air Corps Reserve. He is now stationed at Yale University, where he is studying for a commission.

Wilfred M. Hall has been elected a director of Charles T. Main, Inc., architectural-engineering firm of Boston, Mass.

Frank W. Cawthon was recently promoted from the rank of lieutenant colonel in the Air Corps of the U.S. Army to that of colonel. Colonel Cawthon is technical executive for the Wichita (Kans.) district.

Joseph C. Nowell, Jr., for many years with the Tennessee Valley Authority, has become a lieutenant commander in the Construction Battalions of the U.S. Navy. For the time being he will be stationed at Norfolk, Va.

Herbert S. Riesbol is now a first lieutenant in the Corps of Engineers, U.S. Army, assigned to duty with the Research Section of the Engineer School at Fort Belvoir, Va. He was formerly hydraulic engineer for the U.S. Soil Conservation Service at Moscow, Idaho.

Gordon E. McCallum has been named acting chief sanitary engineer for the Office of Civilian Defense, with headquarters in Washington, D.C. Until lately he has been acting as assistant chief sanitary engineer in the OCD.

Ferdinand J. C. Dresser was recently appointed director of the Construction Division of the War Production Board. Prior to accepting this position, Colonel Dresser was in charge of the engineering section of the Army Specialist Corps.

John C. Geyer is on leave of absence from Johns Hopkins University, where he was an associate in sanitary engineering, in order to serve as assistant chief engineer of the health and sanitation division of the Inter-American Institute, now engaged on sanitation projects in Latin-America.

Herman G. Baity will leave soon for Brazil, where he will be assistant to the sanitary engineer of the Brazilian government, working under the direction of the Office of the Coordinator for Inter-American Affairs. Dr. Baity is professor of sanitary engineering at the University of North Carolina.

George R. Schneider has been promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. He is in charge of the engineering division of the U.S. Engineer Office at Little Rock, Ark.

Robert W. Eddy, formerly sanitary engineer for the Illinois State Department of Public Health, at Robinson, Ill., has been appointed associate sanitary engineer of the Farm Security Administration for Arkansas, Louisiana, and Mississippi.

W. R. Marshall is now chief draftsman for the department of structures of the Erie Railroad Company with headquarters in Cleveland, Ohio. He was previously senior designer.

Amos J. Alter, sanitary engineer for the Indiana State Board of Health, has been commissioned assistant sanitary engineer in the U.S. Public Health Service Reserve and assigned to headquarters of the medical division of the Office of Civilian Defense in Washington, D.C.

John Cash Bridger was recently commissioned a lieutenant (jg) in the Civil Engineering Corps of the U.S. Navy. Prior to being commissioned he was associate professor of civil engineering at Mississippi State College.

Allan W. Carpenter announces his retirement as engineer of bridges in the maintenance-of-way department of the New York Central Railroad, after many years of service. He will continue to live in Yonkers, N.Y.

Howard D. Roler, previously inspector of general construction for the U.S. Engineer Office in New York City, has entered training in the Construction Battalions of the U.S. Navy at Norfolk, Va.

Fred J. Grumm is now assistant state highway engineer in the California State Division of Highways. Until lately he was engineer of surveys and plans for the State Division of Highways.

Royal U. St. John, formerly manager of the San Francisco Bay Airdrome at Alameda, Calif., now has the rank of major in the U.S. Air Force. He is stationed "somewhere in North Africa."

Donald C. A. du Plantier has resigned as associate professor of structural engineering at the University of Alabama in order to join the Vultee Aircraft Company, of Nashville, Tenn., in the capacity of stress analyst.

G. Donald Kennedy has resigned as state highway commissioner of Michigan in order to accept an appointment as vice-president for highway transportation for the Automotive Safety Foundation in Washington, D.C. Mr. Kennedy had been commissioner since 1940.

Norman M. Smith, rear admiral, Civil Engineering Corps, U.S. Navy (retired), has been recalled to active duty and assigned as officer in charge of a newly established Seabee Replacement and Recuperation Center in California. Admiral Smith was chief of the Bureau of Yards and Docks from 1933 to 1937.

T. Keith Legaré has been named area manager for the Columbia (S.C.) office of the War Production Board. For the past year Mr. Legaré has been on leave from his post as assistant construction engineer for the South Carolina State Highway Department while serving as assistant chief engineer on the construction of an Army air base for the Corps of Engineers.

Charles H. Apple, district engineer for the Illinois State Division of Highways, has been transferred from District 1 at Elgin, Ill., to District 10 at Chicago. Other changes in the Division include the transfer of Kendrick Harger from Chicago, where he was district engineer, to District 3 at Ottawa.

Ray F. Lawrence has been promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. At present Colonel Lawrence is in the engineering branch of the construction division of the Office of the Chief of Engineers. Prior to being called to active duty he was associate engineer for the Kansas City (Mo.) engineering firm of Black and Veatch.

DECEASED

Ernest Daniel Bean (Assoc. M. '12) construction and hydraulic engineer of Plattsburg, N.Y., died in a hospital in Montreal, Canada, on February 20, 1943. He was 58. Mr. Bean had been chief engineer of the Palisades Interstate Park Commission and superintendent of the Raymond Concrete Pile Company. More recently (1923 to 1929) he was hydraulic engineer for the J. G. White Management Corporation, and from 1929 to 1931 with the Manila Electric Company in the Philippines. Later he was hydraulic engineer for the Utility Management Corporation in New York, and for the New York State Electric and Gas Corporation at Plattsburg.

James Albert Emery (M. '02) vice-president and director of Ford, Bacon, and Davis, Inc., of New York, N.Y., died at his home in Montclair, N.J., on February 23, 1943. Mr. Emery, who was 70, joined Ford, Bacon and Davis in 1898, becoming vice-president in 1923 and director in 1928. He served this organization as resident engineer in charge of the construction of street railways in New Orleans, Atlanta, and Birmingham, Ala., and from 1903 to 1907 was vice-president and general manager of the Birmingham Railway Light and Power Company.

John Debo Galloway (M. '05) consulting engineer of San Francisco, Calif., died on March 10, 1943, at the age of 73. Long active in the affairs of the Society, Mr. Galloway was elected Honorary Member in 1940. A biographical sketch and photograph appear in the "Society Affairs" department of this issue.

PHILIP DAKIN GILLHAM (M. '31) senior design engineer for the Kentucky State Department of Highways at Frankfort, Ky., died on February 5, 1943. He was 60. From 1905 to 1913 Mr. Gillham was with the Corrugated Bar Company in St. Louis, Mo., and from 1913 to 1924 he was engaged in highway work involving surveys, design, and construction. In the latter year he became connected with the Kentucky State Highway Department in the capacity of designer.

CHARLES T. MAIN (M. '09) chairman of Charles T. Main Inc., of Boston, Mass., died at his home in Winchester, Mass., on March 6, 1943. Mr. Main, who was 87, entered private practice in 1893 as a designer of industrial plants. Earlier (1879 to 1881) he had been a draftsman for the Manchester (N.H.) Mills, and from 1881 to 1892 was engineer and superintendent for the Pacific Mills at Lawrence, Mass. An authority on industrial design, he helped plan the rehabilitation of France after the first World War. Mr. Main was a former president of the American Society of Mechanical Engineers and the Boston Society of Civil Engineers.

BARZILLAI ALLEN RICH (M. '19) engineer for Jackson and Moreland, of Boston, Mass., died on January 26, 1943, at the age of 65. Early in his career Mr. Rich was assistant engineer for various Boston firms engaged in concrete design and construction, and from 1918 to 1920 was division engineer for the Boston Army Supply Base. Later he was a member of the Boston firm of Fay, Spofford, and Thorndike. From 1926 on (except for a brief period with the Massachusetts Department of Public Works and with Metcalf and Eddy) he was structural engineer for Jackson and Moreland.

WILL JOSEPH SANDO (M. '09) consulting engineer of Chicago, Ill., died on February 23, 1943. Mr. Sando, who was 78, had acted as superintendent of pumping stations for the Metropolitan (Massachusetts) Water Board; chief engineer for the International Steam Pump Company, of New York; and manager of the hydraulic turbine department of the Allis-Chalmers Company in Milwaukee. In 1910 Mr. Sando resigned from the Allis-Chalmers Company to establish his own consulting practice. He had been consultant to the cities of Boston, New York, Chicago, Cincinnati, and Milwaukee.

JOHN EATON SHEPARDSON (Assoc. M. '03) civil engineer of Cleveland, Ohio, died on February 12, 1943, at the age of 67. Mr. Shepardson was with the Carolina, Clinchfield and Ohio Railway from 1905 to 1912; terminal engineer for the Holston Corporation at Charleston, S.C., from 1912 to 1917; chief engineer for the Norfolk Southern Drainage Corporation from 1917 to 1924; and valuation engineer for the Nickel Plate Railroad in Cleveland from 1924 to 1927. From the latter year on, except for a brief period, Mr. Shepardson was in private practice in Cleveland.

MARSHALL NEY SHOEMAKER (M. '11) civil engineer of Newark, N.J., died at his home in that city on February 9, 1943, at the age of 70. From 1899 to 1900 Mr. Shoemaker was with A. and P. Roberts Company; from 1900 to 1903, with the American Bridge Company; and from 1903 to 1917, vice-president of the American Concrete-Steel Company. Later for a number of years he maintained a consulting and architectural practice in Newark.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

JOHN RODGERS SPELMAN (M. '22) for the past six years building commissioner for the Village of Rockville Center, N.Y., died at his home there on February 27, 1943. Mr. Spelman, who was 71, for many years maintained a consulting practice in New York. More recently he was consulting engineer for Nassau County (N.Y.). While he was county consultant many projects, including the Long Beach, Bayville, and Oyster Bay bridges, were completed.

ROBERT ELLSWORTH THOMAS (Assoc. M. '22) captain, Civil Engineering Corps, U.S. Navy, was killed in line of duty when a Clipper plane crashed near Ukiah, Calif., on January 21, 1943. He was 51. Captain Thomas had been an officer in the U.S. Navy since 1917, having been public works officer in several Naval Districts. For some years, also, he was in the Bureau of Yards and Docks in Washington, D.C., and at the time of his death was director of the Pacific operations of the Bureau.

ARTHUR WILLIAM VON DER LINN (Assoc. M. '40) technical adviser for the William P. McDonald Construction Company in Flushing, N.Y., died on February 20, 1943. Mr. Von der Linn, who was 48, was with the William P. McDonald Construction Company from 1923 to 1929, and from 1932 on. He served the organization as paving consultant on many of the New York World's Fair projects. From 1929 to 1932 he was with Macasphalt Ltd., in Quebec, Canada.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From February 10 to March 9, 1943, Inclusive

ADDITIONS TO MEMBERSHIP

AVELLA, SALVATORE RALPH (Assoc. M. '43), Member, Laboratory Staff, Bell Telephone Laboratory, 463 West St. (Res., 250 East 200th St.), New York, N.Y.

BARKER, JOSEPH HENRY (Jun. '42), Lt., CEC, U.S.N., 524 Sturges Rd., Fairfield, Conn.

BECKERT, JACK RAYMOND (Jun. '43), Rodman, C. & N.W. Ry., 500 First Ave., North (Res., 807 First Ave., S.), Escanaba, Mich.

BEHNER, JOHN LOUIS (Assoc. M. '43), Design Engr. (Civ.), Leeds, Hill, Barnard & Jewett, 375 Subway Terminal Bldg. (Res., 1023 North Martel Ave.), Los Angeles, Calif.

BELLASSAI, SALVATORE JOHN (Jun. '42), Ensign, E-V (S), U.S.N.R., Route 1, Bridgeport, Conn.

BENEDUM, WILBERT CHARLES (Jun. '43), Civ. Engr., New York Central R.R., Springfield (Res., 159 East Maynard Ave., Columbus), Ohio.

BIXBY, DEANE FRANCIS (Jun. '42), Corporal, U.S. Army, Headquarters Company, 826th Engr. Battalion (Aviation), Army Post Office 875, Care, Postmaster, New York, N.Y.

BLANTON, JACK EDWARD (Jun. '43), Chf. of Party, Arthur G. McKee Co. (Res., 1322 Peabody), Corpus Christi, Tex.

BLESSING, CHARLES ALEXANDER (Assoc. M. '43), Civilian Asst. to Post Engr., Chicago Quartermaster Depot, 1819 West Pershing Rd. (Res., 5121 Woodlawn Ave.), Chicago, Ill.

BREWER, ROBERT BURNS (Jun. '43), Engr. (Civ.), Shoecraft, Drury & McNamee, State Savings Bank Bldg., Ann Arbor (Res., 508 West Oliver St., Owosso), Mich.

BROOKS, KENNETH WILLIAM (Jun. '42), Asst. Engr. (Arch.), U. S. Engr. Dept., 713 North 9th St., Independence, Kans.

BURGESS, JOHN JARVIS (Assoc. M. '43), (Carter & Burgess), 201 Century Bldg., Fort Worth, Tex.

CABELL, PAUL CARRINGTON (Jun. '42), Ensign, CEC, U.S.N.R., Naval Operating Base, Camp Allen, Norfolk, Va.

CADWALLADER, IRA (Jun. '42), Ensign, U.S.N.R., 302 Columbus Ave., Fostoria, Ohio.

CALLAHAN, CLARENCE ANDREW (Jun. '43), Ensign, CEC, U.S.N.R., 526 Simonton St., Key West, Fla.

CARMAN, HENRY VICTOR (Assoc. M. '43), Superv. Engr., Greeley & Hansen, Green St. School Annex, Portsmouth, Va. (Res., 607 East 2d St., Bloomington, Ind.)

CARMICHAEL, JACK CHARLES (Jun. '42), 1st Lt., U.S.Army, Headquarters Company, 406th Infantry, Army Post Office 102, Camp Maxey, Tex.

COLARUSSO, MICHAEL JOHN (Jun. '43), Associate Engr. (Civ.), North Atlantic Div., U.S. Army Engrs., 270 Broadway, New York (Res., 3218 Eighty-Sixth St., Jackson Heights), N.Y.

COLGAN, JOHN CLIFTON (Assoc. M. '43), Shipyard Insp. (Concrete Hulls), U.S. Maritime Comm., McCloskey & Co., Hooker's Point Shipyard, Tampa, Fla.

CUMMINGS, WARREN GEORGE (Jun. '42), Civilian Engr., Bureau of Yards and Docks, U.S.N.; Care, Lt. S. H. Sword, Lukens Steel Co., Coatesville, Pa. (Res., 84–12 Thirty-Fifth Ave., Jackson Heights, N.Y.)

DAVIDSON, JAMES SLATER, JR. (Assoc. M. '43), Chf. Engr., Chas. H. Tompkins Co., 907 Sixteenth St., Washington, D.C. (Res., 6524 Ridgewood Ave., Chevy Chase, Md.)

DAY, RICHARD CHARLES (M. '43), Chf. Engr., Mountain Fuel Supply Co., Rock Springs, Wyo.

DISARIO, PAUL CARMEN, JR. (Jun. '43), Ensign, U.S.N.R., Naval Air Station, Sanford, Fla.

DOUGHERTY, EDWARD MONTEITH (Jun. '43), 1st Lt., Corps of Engrs., U.S. Army, 1708 Yale Ave., Knoxville, Tenn.

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